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PENSOFT

Additions to the flora of Panama, with comments on plant collections and information gaps

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Abstract

In the present study, we report 46 new records of vascular plants species from Panama. The species belong to the following families: Anacardiaceae, Apocynaceae, Aquifoliaceae, Araceae, Bignoniaceae, Burseraceae, Caryocaraceae, Celastraceae, Chrysobalanaceae, Cucurbitaceae, Erythroxylaceae, Euphorbiaceae, Fabaceae, Gentianaceae, Lacistemataceae, Lauraceae, Malpighiaceae, Malvaceae, Marattiaceae, Melastomataceae, Moraceae, Myrtaceae, Ochnaceae, Orchidaceae, Passifloraceae, Peraceae, Poaceae, Portulacaceae, Ranunculaceae, Salicaceae, Sapindaceae, Sapotaceae, Solanaceae, and Violaceae. Additionally, the status of plant collections in Panama is discussed; we focused on the areas where we identified significant information gaps regarding real assessments of plant biodiversity in the country.

Keywords

Central America, floristics, new records, taxonomy, vascular plants.

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Introduction

The Republic of Panama is located in the intertropical zone, between 07°12′08″ and 09°38′46″ north latitude and 077°09′24″ and 083°03′07″ west longitude. Panama is sandwiched between the Caribbean Sea to the north, the Pacific Ocean to the south, the Republic of Costa Rica on the west and the Republic of Colombia on the east. Panama has a land area of 75,845 km^2, the fourth largest among the seven countries of Central America, representing 14.7% of the entire Central American region (ANAM 2010). The territorial organization of the country includes provinces, which are divided into districts and these in turn, are subdivided in corregimientos. Currently, the territorial organization comprises 10 provinces, 79 districts, 664 corregimientos and five indigenous comarcas. In 2014, the province of Panamá Oeste was created, which was segregated from the province of Panamá and comprises the districts that are located to the west of the Panama Canal.

The Isthmus of Panama is a land connection between North America and South America, as an oceanic barrier

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for the Caribbean Sea and the Pacific Ocean. Its formation stands as one of the greatest natural events, as it triggered an interchange of previously isolated terrestrial organisms and opened each continent to invasions by northbound and southbound migrant species, allowing for the Great American Biotic Interchange (Webb 2006; Cione et al. 2015). Although the exact age of formation of the Isthmus is still hotly debated by several scholars (e.g. Coates and Stallard 2013; Bacon et al. 2015; Montes et al. 2015; O'Dea et al. 2016; Jaramillo et al. 2017; Molnar 2017), it appears that the final closure occurred no later than 2.8 Ma (Coates and Stallard 2013; O'Dea et al. 2016).

Panama has a warm, wet, tropical climate with high temperatures throughout the year, with an average of 27 °C and two seasons: wet and dry (in certain regions microclimates generated by nearby mountains or bodies of water are exceptions). The wet period is longer in duration, usually beginning in mid- to late-April and ending the first half of December. The shorter dry season occurs on average from mid-December to mid-April. On the Caribbean slope, annual rainfall amounts to 3500 mm, while on the Pacific coast, to approximately 2300 mm; however, some regions of Darién Province can reach 7000 mm of annual rainfall (ANAM 2010). Approximately 70% of the Panamanian territory is formed by lowlands and hills with less than 700 m elevation. The main highlands are formed by the Cordillera Central (Cordillera de Talamanca in Panamanian territory), a mountain range that extends from the border with Costa Rica to the center of Panama, with elevations gradually decreasing from west to east and includes the highest peak of the Isthmus (Volcán Barú), which attains 3474 m (Correa et al. 2004).

The first documents that included information on the plants of Panama were produced during the period of the Spanish conquest, which mainly reported the uses of local species (Escobar 1971). These publications include the volumes of Fernández de Oviedo in the "Historia General y Natural de las Indias" (published between 1535 and 1547) dealing with the plants, animals, and people of the Isthmus (Velásquez-Runk 2015). Throughout the 17th century, although Spain tried to exclude foreigners from its colonies, European knowledge about the Isthmus advanced mostly through the work of non-Spanish explorers (Seemann 1852–1857); i.e. English buccaneers William Dampier and Lionel Wafer documented some aspects of the geography and riches of the Isthmus (Velásquez-Runk 2015). Wafer and Dampier, in their works originally published in 1697 and 1699 respectively, discussed several aspects about the climate, important localities of the Isthmus, the wildlife, and the use of local plants (Wafer 1699; Shipman 1962; Neill 2000).

The formal study of the flora of Panama began in the early 18th century through collections made mainly by European naturalists (Dwyer 1985). The first botanical collections made in Panamanian territory were done by Scottish botanist James Wallace around the year 1700 (Croat 1978; Dwyer 1968a, 1985). Wallace (1701), in his work titled "A Part of a Journal kept from Scotland to New Caledonia in Darien, with a short Account of that Country" mentioned some aspects of the fauna and flora of the Darién Province, emphasizing the lack of knowledge of the local flora and the morphological complexity of the plants. During the expedition led by Alessandro Malaspina between 1789 and 1794, Luis Née and Thaddeus Haenke collected numerous specimens from Panama (Cerro Ancón, the Bay of Panama, and Taboga Island) (Seemann 1852–1857; Dwyer 1964; Escobar 1971; Garmendia-Muñoz 1992). Subsequently, the Panamanian material collected by Haenke was used for the description of numerous new species in the work "Reliquiae Haenkeanae" published by Presl (1825–1830).

In the 19th century, during the Swedish scientific expedition of Michaelson carried out in the years 1825 and 1826, the botanist J. Billberg made numerous collections in the Province of Colon, in the area of Portobelo (Croat 1978). Years later, Beurling (1854) published the work "Primitiae florae Portobellensis" possibly the first floristic treatment for Panama. As a result of the first authorized expedition to study the possible routes of the interoceanic canal, Lloyd (1831) published the work "Notes respecting the Isthmus of Panama", where he mentioned some uses of Panama's plants, mainly timber tree species. Another important study of this century is that of Bentham (1844), in which he described a significant number of new species from Panama, using the material collected during the expeditions carried out by HMS Sulphur in the years 1836–1842. A few years later, as a result of the expedition of the HMS Herald (1852–1857), the German naturalist Berthold Seemann published his magnificent work "Botany of the Voyage of HMS Herald". In his work, Seemann (1852–1857), devoted an entire chapter to the flora of the Isthmus of Panama, including an annotated list of 1204 species (as well as nomenclatural aspects) and described numerous new species from Panama. In addition, the same chapter added maps, historical notes, ethnobotanical aspects, and information on the vegetation of the Isthmus (Blake and Atwood 1942). Other 19th-century collectors included H. Cuming, R. Hinds, G. Barclay, A. Sinclair, J. von Warscewicz, A. Fendler, M. Halsted, E. Duchassaing, and S. Hayes (Dwyer 1964; Croat 1978).

Although, the formal study of the flora of Panama began in the early 18th century, most of the contributions were made during the 20th century, mainly through the Missouri Botanical Garden (MBG) (Escobar 1971). In the early 1920s, MBG entered the field in Panama, beginning a collection program in association with the Canal Zone Experiment Gardens at Summit (Frodin 2001). The Garden founded a tropical station in the Canal Zone in 1926 (Dressler 1972) and began a series of botanical expeditions in 1934 (Dwyer 1964; Lewis 1968; Croat 1978). Botanical activity leading to a Flora of Panama began with the efforts of R.E. Woodson, Jr with R.W. Schery, R.J. Seibert, J.A. Steyermark, P.C. Allen, A.A.

Hunter, and Carol Dodge (Croat 1978). Later, Robert E. Woodson, Jr published seven "Contributions toward a Flora of Panama" (from 1937 to 1943) using material collected between 1934 and 1941 (Robyns 1965; Lewis 1968). After these preliminary contributions, the Flora of Panama Project itself was commenced in 1943 (Lewis 1968), culminating with the publication of the Checklist by William G. D'Arcy in 1987. The Flora of Panama project was the first major overseas floristic project of the MBG and remains nearly the most complete floristic work from Panama (Escobar 1971). In the Checklist prepared by D'Arcy (1987), 7345 species of vascular plants in 195 families are listed. While the recent "Catálogo de las plantas vasculares de Panamá" (Correa et al. 2004) reports 9520 species of vascular plants, including 1144 endemic species, and showcases the richness of the Panamanian flora, it also highlighted the incompleteness of our knowledge. Currently, the flora of Panama consists of about 10,400 species of vascular plants, including nearly 1500 endemic species (PMA Herbarium unpublished data).

After completion of the checklist by Correa et al. (2004) and through the joint efforts of PMA and other institutions such as the herbaria of the University of Florence (Centro Studi Erbario Tropicale, herbarium FT), MBG, the Natural History Museum of London (BM), the Biodiversity Institute of Costa Rica (INBio), the Smithsonian Tropical Research Institute (STRI), the Ministry of Environment of Panama (MiAmbiente), International Cooperative Biodiversity Group (ICGB), and individuals, new records and species were added to the Flora of Panama. These efforts centered around different regions of the country. For example: a) the Panamanian Caribbean slopes (e.g., Baldini and Ortiz 2014, 2015; Ortiz and Croat 2015a, 2015b, 2016, 2017a; Ortiz et al. 2016, 2018a); b) the district of Donoso in the Province of Colón in connection with the Minera Panamá Project (e.g., Clark and Mora 2014; Daly 2014; Daniel and McPherson 2014; Holst 2014; Kennedy 2014; Idárraga et al. 2015; Schatz et al. 2015; Barrie et al. 2016; Croat and Ortiz 2016; Grayum and De Gracia 2016; Kawasaki et al. 2016; Croat et al. 2017; Batista and Mori 2017; De Gracia et al. 2017; Almeda and Penneys 2018; Prance 2018); and c) La Amistad International Park located in the Cordillera of Talamanca between Costa Rica and Panama's border (e.g., Soto and Monro 2008; Monro 2009, 2012; Rodríguez et al. 2011; Santamaría et al. 2014, 2015; Monro et al. 2017; Ortiz and Croat 2017a, 2017b; Ortiz et al. 2018b; Rodríguez and Solano-Peralta 2018). In addition, the Autonomous University of Chiriquí herbarium (UCH) and the Jardín Botánico Lankester of Costa Rica collected and thoroughly studied the orchid flora of Panama (Bogarín et al. 2013a, 2013b, 2014a, 2014b, 2017; Serracín et al. 2013, 2016). For its part, the ICGB project has carried out fieldwork all over Panama and has found several new species and new records published and unpublished (in process) for the country (Cáceres-González and Ibáñez 2014; Daniel and Carrión 2015; Kennedy and Flores 2015; Flores et al. 2016, 2017, 2018; Maas et al. 2019).

Although many new records have been found and many new species have been described from Panama in recent years, there are still many gaps in assessing the diversity of the local flora. In this work and as a contribution to the efforts still needed to better document Panama's flora, we reported 46 species of vascular plants, which represents new reports for the country, almost all of which were found in areas with substantial information gaps. Additionally, we discuss the main areas where these gaps of information on plant collections in Panama are most prevalent.

Methods

Newly documented species records were confirmed by comparing collected voucher specimens with those identified and housed at Missouri Botanical Garden Herbarium (MO) and University of Panama Herbarium (PMA) (herbaria acronyms according to Thiers 2018). In addition, images of type specimens of each species here included were examined by consulting the JSTOR Global Plants database (JSTOR 2018). Data on species distribution were obtained from Almeda (2007), Balick et al. (2000), Cornejo et al. (2012), Daly (1993), Danin et al. (1978), Davidse (1978), Davidse et al. (2015), Funk et al. (2007), García-Mendoza and Meave (2011), Goldenberg et al. (2013), González-Ramírez (2007), Idárraga et al. (2011), Jeffrey (1978), Jørgensen and León-Yánez (1999), Jørgensen et al. (2014), Lombardi (2014), Morales (2007, 2014, 2015), Penneys and Judd (2013), Plowman and Barrie (2010), Sánchez-Ken (2017), Secco (2004), TROPICOS (2019a), Wang (2004), Zamora (2010) and Zuloaga et al. (2003). Distribution maps for all new species records are presented in Figures 3–5.

To establish areas with plant information gaps, we used the collection databases of PMA and MO for vascular plant specimens collected in Panama (considering only specimens that have coordinates available); these totaled 123,521 records. These records were related with a layer grid, where each cell measured 10 km^2, and only cells with 50 records or more were mapped. All this information was processed using ArcGIS 10.4 for Desktop to generate Figure 6, to find where regions without information remain.

Results

New Records to the Panamanian Flora

ANACARDIACEAE

Ochoterenaea colombiana F.A. Barkley, Bull. Torrey Bot. Club 69: 442 (Barkley 1942).
Figure 2A

New records. Coclé. La Pintada, vertiente Atlántica; 08°36′ N, 080°27′ W; 600 m; 12 Nov. 2007; *C. Guerra et al. 1147* (PMA). **Colón**. Área del proyecto minero de

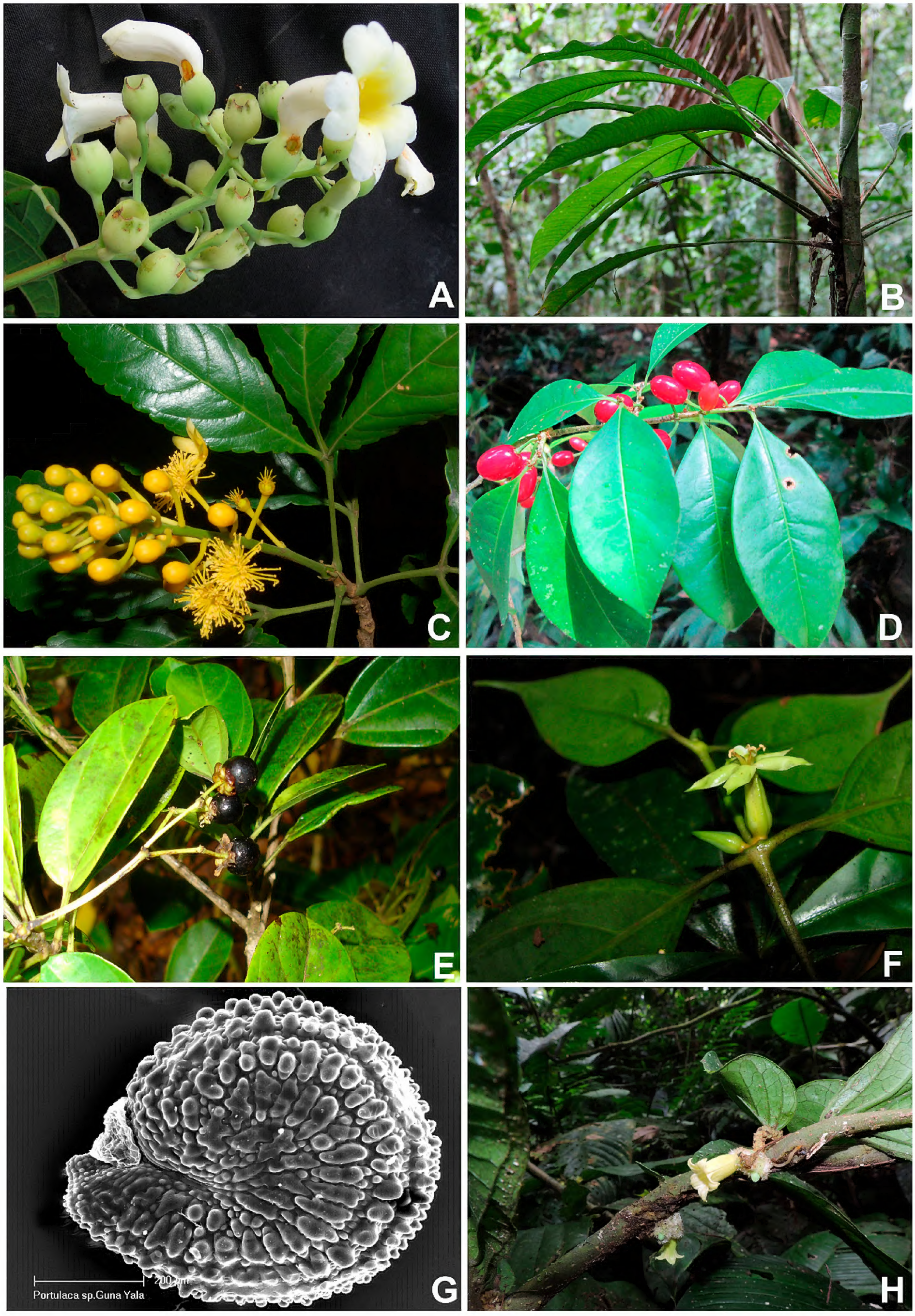

Figure 1. Selected new records for Panama. **A.** *Amphilophium chocoense* (*McPherson 20358*). **B.** *Rhodospatha monsalveae* (*Espinosa 6014*). **C.** *Anthodiscus chocoensis* (*Hammel 26289*). **D.** *Erythroxylum fimbriatum* (*Vergara-Pérez 576*). **E.** *Hasseltia lateriflora* (*Flores 574*). **F.** *Tachia parviflora* (*Araúz 1428*). **G.** *Portulaca papillato-stellulata* (seed) (*Ortiz & Baldini 1129*). **H.** *Cuatresia trianae* (*McPherson 21565*). Photo credits: Cynthia Lane (A), Alex Espinosa (B), Barry Hammel (C), Irving Vergara-Pérez (D), Rodolfo Flores (E), Jan Meerman (F), Riccardo Baldini (G), Christel Ramos (H).

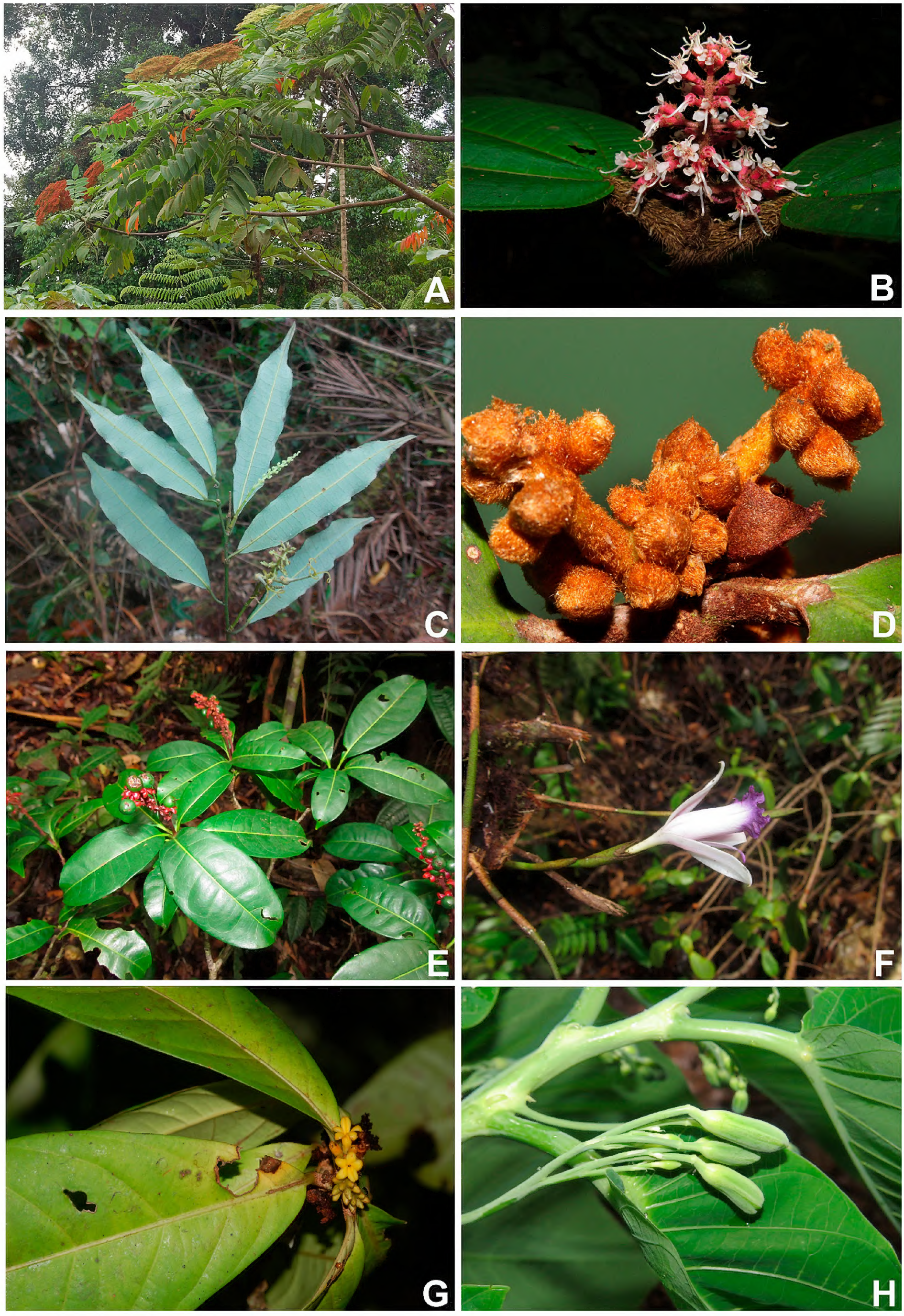

Figure 2. Selected new records for Panama. **A.** *Ochoterenaea colombiana* (*Araúz & De Gracia 2024*). **B.** *Miconia paleacea* (*Ortiz 1214*). **C.** *Mabea tenorioi* (*McPherson 21574*). **D.** *Calyptranthes bracteata* (*Espinosa 6006*). **E.** *Byrsonima garcibarrigae* (*Ortiz 1420*). **F.** *Sobralia purpurella* (*Ortiz 1243*). **G.** *Paypayrola confertiflora* (*Hammel 6313*). **H.** *Passiflora macrophylla* (*Ortiz 2907*). Photo credits: Barry Hammel (A, G), Orlando Ortiz (B, E, F, H), Betzabeth Henríquez (C), Alex Espinosa (D).

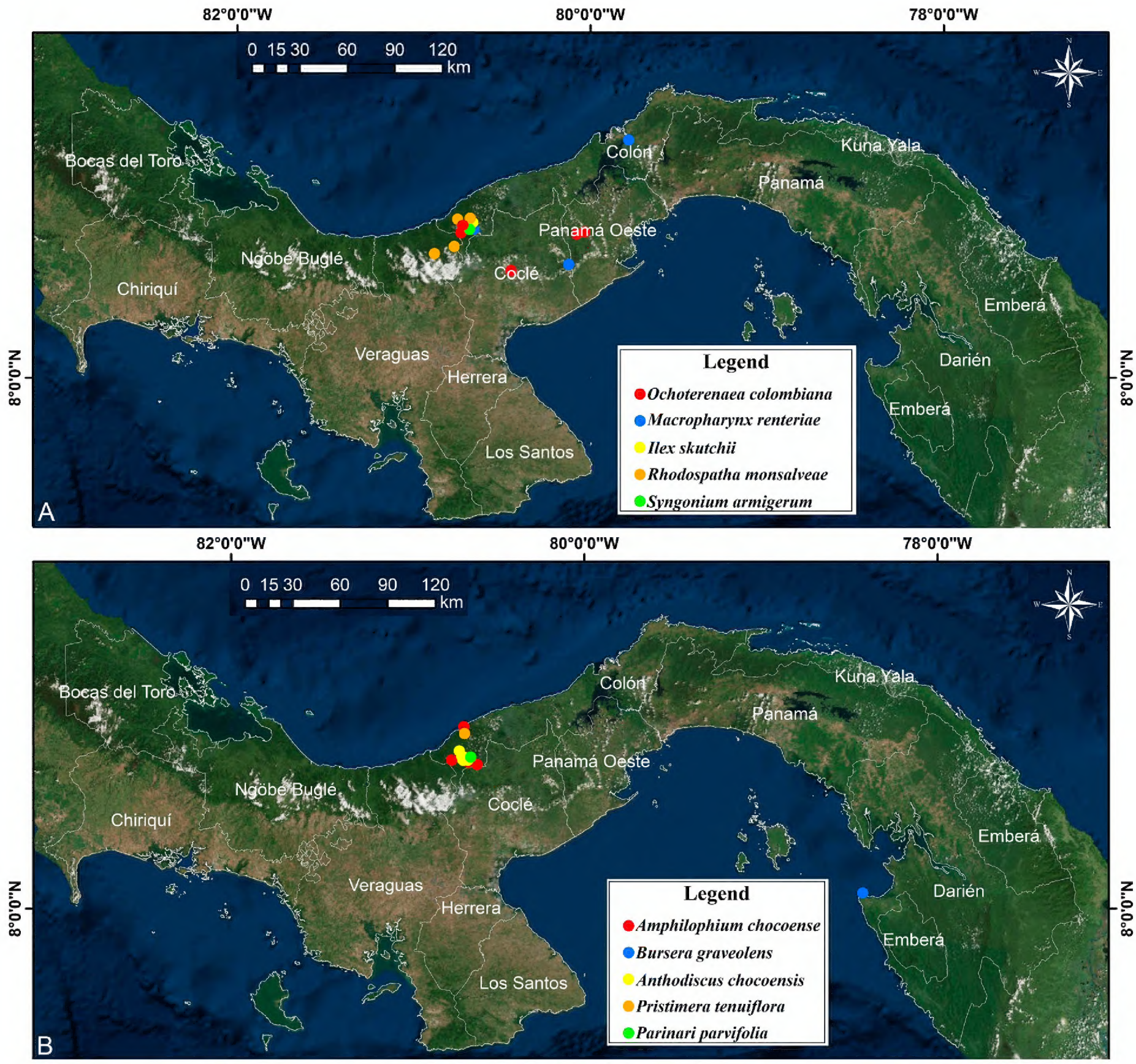

Figure 3. Distribution map with new record specimens (circles). **A.** *Ochoterenaea colombiana*, *Macropharynx renteriae*, *Ilex skutchii*, *Rhodospatha monsalveae* and *Syngonium armigerum*. **B.** *Amphilophium chocoense*, *Bursera graveolens*, *Anthodiscus chocoensis*, *Pristimera tenuiflora* and *Parinari parvifolia*. **C.** *Gurania bignoniacea*, *Erythroxylum fimbriatum*, *Aparisthmium cordatum* and *Mabea tenorioi*.

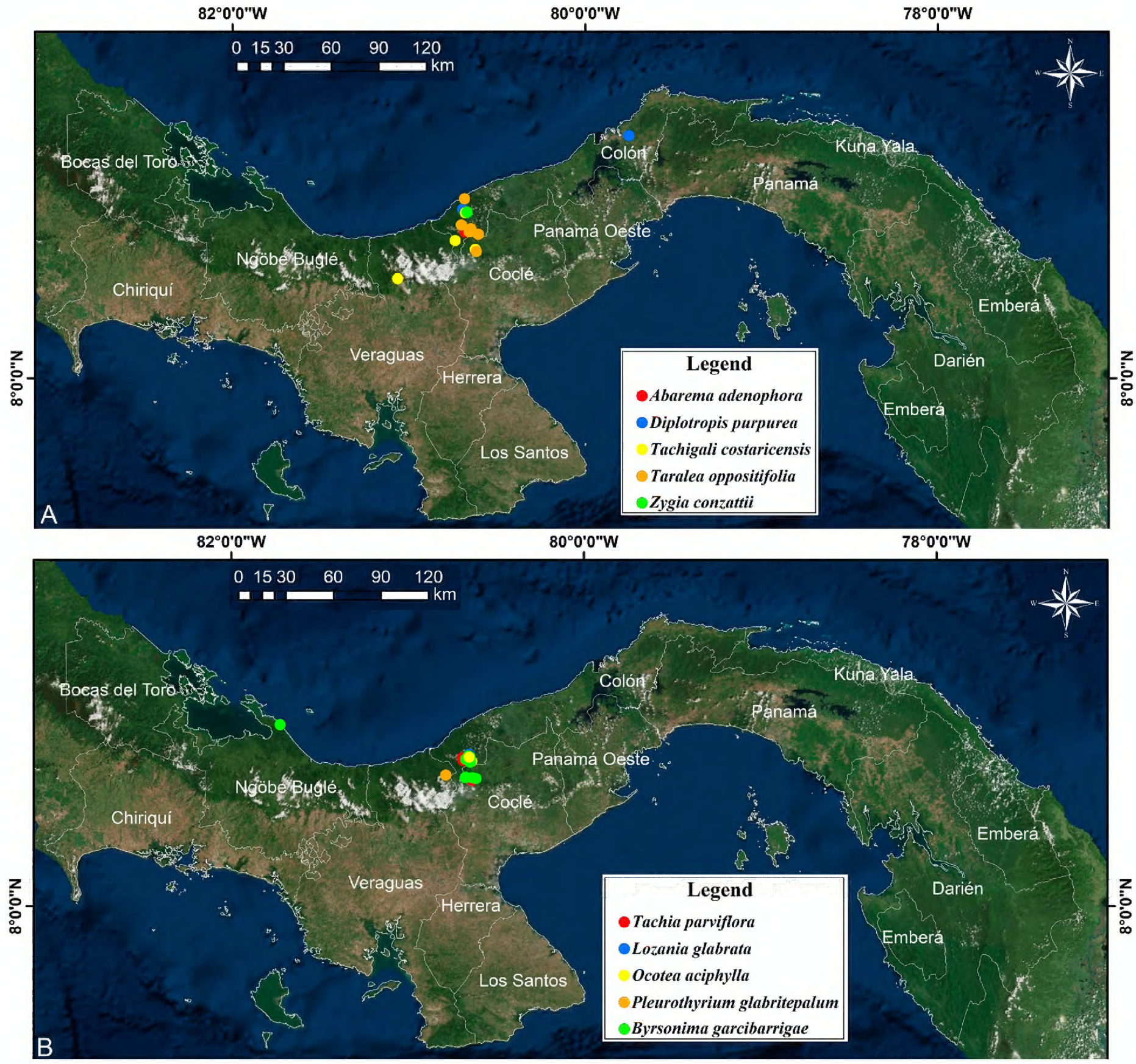

Figure 4. Map showing the distribution of selected new reports (circles). **A.** *Abarema adenophora*, *Diplotropis purpurea*, *Tachigali costaricensis*, *Taralea oppositifolia* and *Zygia conzattii*. **B.** *Tachia parviflora*, *Lozania glabrata*, *Ocotea aciphylla*, *Pleurothyrium glabritepalum* and *Byrsonima garcibarrigae*. **C.** *Pentaplaris doroteae*, *Danaea grandifolia*, *Blakea dimorphophylla*, *Henriettea odorata* and *Miconia paleacea*.

Figure 5. Map showing the distribution of selected new reports (circles). **A.** *Ficus donnell-smithii*, *Calyptranthes bracteata*, *Eugenia albicans*, *Ouratea rinconensis* and *Sobralia purpurella*. **B.** *Passiflora macrophylla*, *Pera oppositifolia*, *Digitaria costaricensis*, *Lasiacis ligulata*, *Lasiacis sloanei* and *Portulaca papillato-stellulata*. **C.** *Clematis populifolia*, *Hasseltia lateriflora*, *Vouarana anomala*, *Pouteria bulliformis*, *Cuatresia trianae* and *Paypayrola confertiflora*.

Petaquilla, helipad C08, Río Belencillo; 08°48′41″ N, 080°43′59″ W; 26 Jul. 2009; *B. Araúz & J. De Gracia 2024* (MO, PMA); ibid., Sierra 1 (a un costado de la parcela de restauracion 2.5), bosque secundario intervenido; 08°49′54″ N, 080°41′05″ W; 291 m; 27 Jul. 2015; *J. Batista 1399* (MO, PMA). **Panamá Oeste.** Carretera que conduce al pueblo de Ciri Grande; 08°49′52″ N, 080°02′39″ W, 13 Jun. 2011; *R. Pérez et al. 2468* (MO, SCZ); Carretera Santa Rita-Ciri Grande, km 30; 08°48′17″ N, 080°04′42″ W; 218 m; 17 Apr. 2012; *C. Galdames et al. 7032* (MO, SCZ); ibid.; 14 Jun. 2012; *J. Aranda 4203* (MO). Figure 3A.

Global distribution. Bolivia, Colombia, Panama, and Venezuela.

Identification. *O choterenaea c olombiana* i s d istinguished by having imparipinnate leaves, flowers many in thyrsi at the ends of the short lateral branches, five persistent sepals, five petals and stamens, prominent disk, tricarpellate pistil with one fertile carpel and very flattened fruits, long-pilose along the margin. So far, this is the only species described for the genus *Ochoterenaea* (Barkley 1942).

APOCYNACEAE

Macropharynx renteriae A.H. Gentry, Phytologia 47: 99 (Gentry 1980).

New records. Coclé. Distrito de El Valle, colectado después de las granjas de pollos, a orillas de vía que va hacia la entrada del Sendero El Gaital; 08°37′49″ N, 080°65′69″ W; 800 m; 28 Jun. 2017; *E. Campos 960* (PMA). **Colón.** Teck Cominco Petaquilla mining concession, forested slopes along ridge road; 08°49′56″ N, 080°39′32″ W; 130 m; 9 Mar. 2008; *G. McPherson 20490* (MO, PMA); Distrito de Colón, colectado a orillas de la vía de Santa Rita; 09°19′47″ N, 079°46′59″ W; 247 m; 15 Jul. 2015; *E. Campos 485* (PMA, SCZ). Figure 3A.

Global distribution. Colombia, Costa Rica, Ecuador, Honduras, and Panama.

Identification. This species is distinguished by having puberulent terete branches, leaves with ferruginous-puberulous petioles, broadly elliptic to ovate-elliptic blades, rounded at base and acute or caudate-acuminate at apex, conspicuously bracteate inflorescences (one to many flowers) with long pedicels, flowers with foliaceous sepals, narrowly elliptic, acute apically and a tubular-infundibuliform white corolla (Gentry 1980). *Macropharynx renteriae* is the only representative of the genus in Central America (previously reported in Costa Rica) (Morales 1997).

AQUIFOLIACEAE

Ilex skutchii Edwin ex T.R. Dudley & W.J. Hahn in Hahn, Novon 6: 181 (Hahn 1996).

New records. Colón. Westernmost part of province, site of proposed copper mine (INMET), tailings area, lowland forest; 08°52′10″ N, 080°40′00″ W; 75 m; 13 Apr. 2009; *G. McPherson & Jean-Yves Serein 20936* (MO, PMA). Figure 3A.

Global distribution. Costa Rica, Nicaragua, and Panama.

Identification. This species is characterized by having elliptic to ovate or obovate blades, acute to apiculate at the apex, margins flat, venation the same color as the blades, prominent stigmatic residue, green or light brown young stems (when dry), peduncles and pedicels usually recurved (ca 0.5 mm in diameter) and spherical to globose fruits (2.5–3.5 mm long) (Hahn 1996). In Panama, *I. skutchii* is most similar to *I. fortunensis* W.J. Hahn, which differs in having thicker peduncles (2–3 mm diam.) and smaller fruits (0.9–1.1 mm long) (Hahn 1993).

ARACEAE

Rhodospatha monsalveae Croat & D.C. Bay in Croat and Mora, Aroideana 27: 123 (Croat and Mora 2004). Figure 1B

New records. Colón. Teck Cominco Petaquilla mining concession, forest near helipad H44; 08°53′17″ N, 080°45′09″ W; 160 m; 30 Jun. 2008; *G. McPherson 20754* (MO); Coclé del Norte, área del helipad T02A, caminando hacia la ruta oeste; 08°53′34″ N, 080°40′55″ W; 138 m; 19 Jul. 2012; *A. Espinosa 6014* (MO). **Veraguas**. Santa Fe, Parque Nacional Santa Fe, bosque secundario abierto, bastante plano; 08°41′44″ N, 080°53′00″ W; 290 m; 8 Feb. 2014; *A. Morris et al. 2086* (MO); Santa Fe, área del Rio Piedra, trocha bordeando la ribera del río, bosque muy húmedo con una alta presencia de epífitas y briófitos en los árboles; 08°44′06″ N, 080°46′19″ W; 16 Dec. 2013; *L. Martínez et al. 1558* (MO). Figure 3A.

Global distribution. Colombia, Ecuador, and Panama.

Identification. The species is characterized by its light-brown, conspicuously fissured stems, petioles sheathed to the geniculum, usually drying reddish brown with the sheath usually deciduous with dark-brown persistent fragments and blades which are more or less equilateral and decurrent at the base, drying usually grayish above and reddish brown and minutely dark-granular (pellucid-punctate lines) on the lower surface (Croat and Mora 2004). *Rhodospatha monsalveae* is similar to *R. pellucida* Croat & Grayum, which differs in having blades with numerous pellucid-punctate lines on lower surfaces.

Syngonium armigerum (Standl. & L.O. Williams) Croat, Ann. Missouri Bot. Gard. 68: 585 (Croat 1981).
(≡) *Philodendron armigerum* Standl. & L.O. Williams, Ceiba 3, 1952.

New records. Colón. Teck Cominco Petaquilla mining concession, forest near current end of Petaquilla road; 08°49′52″ N, 080°41′05″ W; 290 m, 28 Jun. 2008; *G. McPherson 20717* (MO, PMA). Figure 3A.

Global distribution. Costa Rica and Panama.

Identification. The species is characterized by its scan-

dent hemiepiphytic habit, brown-drying stems with longitudinal wrinkles, short petioles (5–7 cm long), oblong to oblong-elliptic simple blades with obscure black punctations on the lower surfaces, weakly lobed at the base (the lobes broadly triangular or rounded), few primary lateral veins (five to six pairs) and usually one inflorescence per node (Croat 1981). In Panama, *Syngonium armigerum* is similar to *S. brewsterense* Croat & Delannay, which differs in having longer petioles (21–45 cm long) and two inflorescences per node (Croat et al. 2019).

BIGNONIACEAE

Amphilophium chocoense (A.H. Gentry) L. G. Lohmann, Ann. Missouri Bot. Gard. 99: 402 (Lohmann 2014).
(≡) *Distictella chocoensis* A.H. Gentry, Phytologia 47, 1980.
Figure 1A

New records. Colón. Teck Cominco Petaquilla mining concession, forest along Río Caimito, near mouth; 09°01′06″ N, 080°40′56″ W; 5 m; 1 Mar. 2008; *G. McPherson 20358* (MO, PMA); ibid., forest near helipad, 8°50'05" N, 80°38'48" W; 140 m; 20 Jun. 2008; *G. McPherson 20547* (MO, PMA); Site of proposed copper mine (MPSA), forested slopes; 08°48′27″ N, 080°36′20″ W; 100 m; 13 Dec. 2009; *G. McPherson & M. Merello 21292* (MO, PMA); Coclé del Norte, colectada a orillas de la carretera frente al punto de liberaciones de serpientes (Proyecto Minera Panamá, S.A.); 08°50′ N, 080°45′ W; 2009–2010; *Y. Yaleman et al. 64* (MO, PMA); Donoso, área de concesión de Minera Panamá, frente a Botadero 500, a orilla de la calle; 08°49′15″ N, 080°39′22″ W; 55 m; 2 Jul. 2012; *J.F. Carrión 815* (PMA). Figure 3B.

Global distribution. Colombia and Panama.

Identification. This species is distinguished by having short (0.03–0.7 mm long) trichomes along the branchlets and petioles, broad pseudostipules (width 1/2 to equal length), bifoliolate leaves with petiolules shorter than petioles, ovate, lanceolate or elliptic leaflets, pubescent on the lower surface, tertiary veins raised on lower surfaces (more raised than higher order venation) and immersed on upper surfaces, and ovaries without a stipe. *Amphilophium chocoense* differs from the other Panamanian congener, *A. magnoliifolium* (Kunth) L.G. Lohmann, by having pubescent leaflets on lower surfaces (Pool 2009).

BURSERACEAE

Bursera graveolens (Kunth) Triana & Planch., Ann. Sci. Nat., Bot., sér. 5, 14: 303 (Triana and Planchon 1872).
(≡) *Elaphrium graveolens* Kunth, Nov. Gen. Sp., IV ed. 7, 1824.

New records. Darién. Chepigana, Parque Nacional Darién, Punta Garachiné, bosque seco tropical; 08°05′18″ N, 078°25′23″ W; 200 m; 22 Jun. 2013; *J.F. Carrión 1175* (PMA). Figure 3B.

Global distribution. Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, and Venezuela.

Identification. This species is distinguished by having once-pinnate leaves with winged rachis, bright green leaflets with crenate margins, pubescent to glabrous (not densely tomentose), attenuate to long acuminate at the apex, non-exfoliating bark, tetramerous flowers, deltoid sepals, dehiscent fruits in two valves and a white pseudoaril (Daly 1993). In Panama, *B. graveolens* is most similar to *B. tomentosa* (Jacq.) Triana & Planch., which also has leaves with winged rachis. *Bursera tomentosa* differs in having densely tomentose leaflets and lanceolate sepals.

CARYOCARACEAE

Anthodiscus chocoensis Prance, Brittonia 32: 530 (Prance 1980).
Figure 1C

New records. Colón. Donoso, westernmost part of province, site of proposed copper mine (INMET), along route of proposed road, lowland forest; 08°53′04″ N, 080°42′27″ W; 150 m; 12 Apr. 2009, *G. McPherson 20902* (MO); Área del proyecto minero Petaquilla, 08° 51′25″ N, 080°41′40″ W; 21 Jan. 2008; *N. Guerrero 1213* (MO); ibid.; 08°51′ N, 080°41′ W; 28 Jun. 2008; *N. Guerrero et al. 1413* (MO); MPSA Concession, Valle Grande, Sierra 19; 08°49′54″ N, 080°41′05″ W; 291 m; 17 May 2012; *B. Hammel et al. 26219* (MO); ibid., trail to Petaquilla Camp; 08°49′59″ N, 080°41′11″ W; 270 m; 20 May 2012; *B. Hammel et al. 26289* (MO); Teck Cominco Petaquilla mining concession, forested slopes along ridge road; 08°49′56″ N, 080°39′32″ W; 130 m; 9 Mar. 2008; *G. McPherson 20479* (MO). Figure 3B.

Global distribution. Colombia, Costa Rica, and Panama.

Identification. *Anthodiscus chocoensis* differs from other species within the genus by the larger (12–15 × 6–7 cm) acuminate leaves, coriaceous blades, the shorter leaf apex, the longer petiolules and shorter petioles and the thicker inflorescence and pedicels (Prance 1980). The specimens cited here represent the first records of the genus *Anthodiscus* in Panama.

CELASTRACEAE

Pristimera tenuiflora (Mart. ex Peyr.) A.C. Sm., Brittonia 3: 382 (Smith 1940).
(≡) *Hippocratea tenuiflora* Mart. ex Peyr., Fl. Bras. 11, 1878.

New records. Colón. Donoso, Teck Cominco Petaquilla mining concession, forest along river's banks, Caimito River; 08°58′53″ N, 080°40′40″ W; 5 m; 27 Feb. 2008; *G. McPherson 20253* (MO, PMA). Figure 3B.

Global distribution. Colombia, Costa Rica, Brazil, French Guiana, Nicaragua, Panama, Peru, Suriname, and Venezuela.

Identification. According to Lombardi (2015), *Pristimera* can be recognized in sterile specimens by its greenish-drying blades with cream-colored veins, but the identification of the species in this condition is very

difficult or impossible. *Pristimera tenuiflora* differs from other Neotropical species of the genus in having tubular flowers and ovate segments on fruits and seeds with the wing partially surrounding the seminiferous nucleus (Lombardi 2015).

CHRYSOBALANACEAE

Parinari parvifolia Sandwith, Bull. Misc. Inform. Kew 1931: 374 (Sandwith 1931).

New records. Colón. Donoso, MPSA Concession, intact forest, bosque primario; 08°50′59″ N, 080°38′29″ W; 29 Aug. 2008; *N. Guerrero NG1642* (PMA). Figure 3B.

Global distribution. Brazil, Colombia, Costa Rica, French Guiana, Guyana and Panama.

Identification. *Parinari parvifolia* is distinguished by having petioles with two inconspicuous glands near the blade, terete petioles, elliptic to oblong-lanceolate blades, numerous primary veins (27–30 pairs) and a slightly impressed midrib for its entire length on upper surface (Prance 1972). Previously, the only species reported for this genus in Panama was *P. chocoensis* (Correa et al. 2004), which differs from *P. parvifolia* in having a midrib impressed only on the proximal portion of the blade and canaliculate petioles.

CUCURBITACEAE

Gurania bignoniacea (Poepp. & Endl.) C. Jeffrey, Kew Bulletin 33: 354 (Jeffrey 1978).
(≡) *Anguria bignoniacea* Poepp. & Endl., Nov. Gen. Sp. Pl. 2, 1838.

New records. Colón. Donoso, Coclé del Norte, área del helipad Escorpio 02, tomando la ruta sur; 08°55′29″ N, 080°40′08″ W; 60 m; 21 Jul. 2012; *A. Espinosa 6026* (MO, PMA). **Panamá.** East slope of Cerro Jefe, cloud forest; 09°14′02″ N, 079°22′20″ W; 823 m; 8 Feb. 1966; *E. Tyson 3401* (MO). Figure 3C.

Global distribution. Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname, and Venezuela.

Identification. Wunderlin (1978a) made taxonomic combinations in *Anguria* and proposed *Psiguria bignoniacea* (Poepp. & Endl.) Wunderlin, which was transferred to *Gurania* as *G. bignoniaceae* (Poepp. & Endl.) C. Jeffrey (Jeffrey 1978). An earlier report of this species [referred as *P. bignoniacea* (Poepp. & Endl.) Wunderlin] in the Flora of Panama treatment (Wunderlin 1978b), was erroneously based on *P. triphylla* (Miq.) C. Jeffrey (Jeffrey 2001), which differs in having glabrous leaves and flowers with a green hypanthium (vs reddish in *Gurania*). As currently circumscribed, *G. bignoniacea* is a complex, which is characterized by membranous trifoliolate or simple leaves and an indumentum (when developed) of rather coarse, scattered, fairly long hairs on the petioles, leaves, and hypanthia (Jeffrey 1978). In Panama, *G. bignoniacea* could be confused with *G. coccinea* Cogn., but the latter differs in having shorter glabrescent pedicels and glabrous fruits.

ERYTHROXYLACEAE

Erythroxylum fimbriatum Peyr. in Martius, Fl. Bras. 12: 162 (Peyritsch 1878).
Figure 1D

New records. Coclé. Above El Copé, along road to Caribbean side, Atlantic slope; 08°38′ N, 080°35′ W; 720–800 m; 31 Aug. 1988; *G. McPherson 12862* (MO). **Colón.** Área del proyecto minero Petaquilla, Valle Grande, antiguo campamento cuatro crestas; 21 Jun. 2009, *B. Araúz 1939* (PMA); ibid., Quebrada Brazo; 08° 49′01″ N, 080°38′30″ W; 147 m; 17 Jun. 2014; *I. Vergara-Pérez 576* (MO, PMA). **Panamá.** Chepo, Isla Majé-Bayano; 09°09′30″ N, 078°49′52″ W; 50–100 m, 23 Aug. 1976; *L. Aguilar 166* (MO). Figure 3C.

Global distribution. Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Nicaragua, Panama, Peru, and Venezuela.

Identification. *Erythroxylum fimbriatum* is easily recognized by its small and striated persistent stipules (0.15–0.2 cm long), with the two recurved lateral setae, often fimbriated at apex and fruits with endocarp pointed at apex (Jara-Muñoz 2015). This species is most similar to *E. citrifolium* A. St.-Hil., which differs in having longer (0.4–1.2 cm long) and deciduous stipules (Plowman and Barrie 2010).

EUPHORBIACEAE

Aparisthmium cordatum (A. Juss.) Baill., Adansonia 5: 307 (Baillon 1865).
(≡) *Conceveibum cordatum* A. Juss., Euphorb. gen. 43, 1824.

New records. Panamá Oeste. Río Indio, Los Chorros, orilla de la carretera; 08°46′26″ N, 080°07′49″ W; 401 m; 5 Jun. 2019; *R. Flores 4154* (PMA, UCH); Carretera El Espino-río Indio, Oeste de La Chorrera, km 30 desde la Carretera Interamericana; 08°48′21″ N, 080°05′39″ W; 300 m; 8 Jul. 2014; C. Galdames 7615 (PMA, SCZ); ibid.; C. Galdames 7616 (PMA, SCZ). Figure 3C.

Global distribution. Bolivia, Brazil, Costa Rica, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname, and Venezuela.

Identification. *Aparisthmium* is a monotypic genus that includes the following characters: leaves with two stipel-like appendages at the apex of the petiole, four sepals, three to five stamens, capsules with three mericarps with ovate to elliptic seeds (Secco 2004). This genus could be confused with species of *Alchornea* and *Conceveiba*, but both differs in having capsules with two mericarps and stellate trichomes, respectively.

Mabea tenorioi Mart. Gord., J. Jiménez Ram. & Cruz Durán, Anales Inst. Biol. Univ. Nac. Autón. México, Biol. 71: 93 (Martínez-Gordillo et al. 2000).
Figure 2C

New records. Colón. Distrito de Donoso, área de concesión de Minera Panamá, Botija Pit, área 1; 08°50′33″ N, 080°38′56″ W; 23 Sept. 2013; *J.F Carrión 863* (PMA);

Donoso; 08°49′25″ N, 080°41′09″ W; 22 Jul. 2008; *N. Guerrero 1359* (PMA); Teck Cominco Petaquilla mining concession, forested slopes; 08°50′17″ N, 080°38′52″ W; 171 m; 3 Dec. 2007; *G. McPherson & H. van der Werff 19940* (MO, PMA); ibid., slopes along exploration road; 08°50′22″ N, 080°38′51″ W; 184 m; 15 Sept. 2007; *G. McPherson 19559* (MO, PMA); MPSA mining site, forested slopes along trail called Quatro Crestos; 08°49′24″ N, 080°42′32″ W; 201 m; 3 Sept. 2014; *G. McPherson & M. Grayum 21574* (MO, PMA); Área de estudio poblaciones EdI, zona de proyecto, punto 3 (ZP-P3), bosque húmedo tropical, sobre una pendiente, área de Botija; 08°50′35″ N, 080°39′27″ W; 190 m; 9 Feb. 2011; *L. Martínez et al. 751* (MO, PMA); Botija Rd., carretera pionero; 08°50′06″ N, 080°39′17″ W; 12 Sept. 2012; *H. van der Werff et al. 24448* (MO, PMA); Área de concesión del Proyecto Minera Cobre Panamá S. A., Botija, MSA, área 43; 08°50′53″ N, 080°39′34″ W; 134 m; 30 Nov. 2015; *I. Vergara-Pérez 1038* (MO, PMA); ibid., Valle Grande, camino hacia Petaquilla; 08°49′59″ N, 080°41′09″ W; 1 Oct. 2014; *I. Vergara-Pérez 903* (MO, PMA). Figure 3C.

Global distribution. Mexico and Panama.

Identification. This species is characterized by having linear-lanceolate blades with distinct glands, whitish on lower surface, staminate flowers with 10 anthers, unequal (central distinctly larger than laterals) and apparently non-articulate pedicels, erect bracts with lateral glands, free part of styles diffuse and reflexed style-branches (Martínez-Gordillo et al. 2000). In Panama, *M. tenorioi* could be confused with *M. montana* Müll. Arg., which differs in having staminate flowers with more than 10 anthers and equal-sized pedicels.

FABACEAE

Abarema adenophora (Ducke) Barneby & J.W. Grimes, Mem. New York Bot. Gard. 74: 74 (Barneby and Grimes 1996).
(≡) *Pithecellobium adenophorum* Ducke, Arq. Inst. Biol. Veg. 4, 1938.

New records. Colón. Teck Cominco Petaquilla mining concession, forest along creek; 08°49′43″ N, 080°39′37″ W; 237 m; 30 Nov. 2007; *G. McPherson & H. van der Werff 19890* (MO, PMA); San Juan del General, Concesión del Proyecto Mina de Cobre Panamá, Valle Grande, Sierra 18, bosque secundario maduro; 08°49′18″ N, 080°40′58″ W; 280 m; 25 Jul. 2014; *J. De Gracia et al. 793* (MO, PMA). Figure 4A.

Global distribution. Brazil, Costa Rica, Honduras, Nicaragua, Panama, Peru, and Venezuela.

Identification. *Abarema adenophora* is distinguished from other Central American species of the genus by having usually two to four pairs of leaflets per pinna, a large (5–15 × 4–12 mm) funnelform-campanulate first petiolar nectary and dimorphic flowers (Barneby and Grimes 1996). This species could be confused with *A. macradenia* (Pittier) Barneby & J.W. Grimes, which differs in having more than seven pairs of leaflets per pinna (Zamora 2010).

Diplotropis purpurea (Rich.) Amshoff, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 52: 43 (Amshoff 1939).
(≡) *Tachigali purpurea* Rich., Actes Soc. Hist. Nat. Paris 1, 1792.

New records. Colón. Site of proposed copper mine (MPSA), forested slopes; 08°56′54″ N, 080°41′42″ W; 140 m; 5 Dec. 2009; *G. McPherson & M. Merello 21135* (MO, PMA); Site of proposed copper mine (MPSA), forested slopes; 08°48′27″ N, 080°36′20″ W; 100 m; 13 Dec. 2009; *G. McPherson & M. Merello 21287* (MO, PMA); Santa Rita-Aguas Claras, parcela #31, 09°21′36″ N, 079° 45′2″ W; 7 Aug. 2003; *R. Pérez 1065* (PMA). Figure 4A.

Global distribution. Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Suriname, and Venezuela.

Identification. This species is distinguished by its arboreal habit (up to 40 m), leaflets with prominently unequal bases, panicles with several branches and fruits membranous, samaroids (Vásquez 1997). The specimens cited here represent the first records of the genus *Diplotropis* in Panama.

Tachigali costaricensis (N. Zamora & Poveda) N. Zamora & van der Werff, Harvard Pap. Bot. 15: 149 (van der Werff and Zamora 2010).
(≡) *Sclerolobium costaricense* N. Zamora & Poveda, Novon 1, 1991.

New records. Coclé. El Harino, Parque Nacional G.D. Omar Torrijos Herrera, colectado camino al río Tife, área de Cano Sucio, a orillas del río Cano Sucio, terrenos del señor Ife; 08°43′21″ N, 080°37′24″ W; 231 m; 17 Oct. 2012; *L. Martínez 1078* (MO, PMA). **Colón.** MPSA Con-cession, Botadero 600, plants collected after area was cleared with chainsaws; 08°49′19″ N, 080°39′22″ W; 22 May 2012; *B. Hammel et al. 26323* (MO, PMA); Site of proposed copper mine (MPSA), forested slopes; 08°55′43″ N, 080°40′48″ W; 75 m; 4 Dec. 2009; *G. McPherson & M. Merello 21114* (MO, PMA); Coclé del Norte, helipad C16, rumbo norte, curso superior del río Boca Chica, área boscosa cerca al río; 08°46′21″ N, 080° 44′14″ W; 29 Aug. 2012; *A. Zapata 3060* (MO, PMA). **Veraguas.** Parque Nacional Santa Fe, área del río Santa María (ent-rando por Piragual), bosque intervenido; 08° 33′17″ N, 081°02′48″ W; 404 m; 20 Nov. 2012, *L. Martínez et al. 1166* (MO, PMA). Figure 4A.

Global distribution. Costa Rica, Nicaragua, and Panama.

Identification. This species is distinguished by having pectinate (like little pinnate leaves) and usually persistent stipules, leaflets with dense gold or gray sericeous pubescence on lower surfaces and inflorescences and flower buds with brown pubescence (van der Werff and Zamora 2010; Zamora 2010). *Tachigali costaricensis* could be confused with *T. panamensis* van der Werff & N. Zamora, but the latter differs in having scattered indumentum on lower leaflet surfaces and inflorescences and flower buds with reddish-brown pubescence.

Taralea oppositifolia Aubl., Hist. Pl. Guiane 2: 745, t. 298 (Aublet 1775).

New records. Coclé. El Harino, Parque Nacional G.D. Omar Torrijos H, La Rica, camino al río Tife, área del río Blanco; 08°42′43″ N, 080°37′01″ W; 375 m; 18 Oct. 2012; *A. Zapata et al. 3086* (MO, PMA). **Colón.** Donoso; 10 September 2008; *B. Araúz 1807* (MO, PMA); Coclé del Norte, Minera Panamá, helipat H55; 08°51′35″ N, 080°42′09″ W; 182 m; 16 Dec. 2010; *A. Espinosa 5914* (MO, PMA); Teck Cominco Petaquilla mining concession, forested slopes; 08°50′17″ N, 080°38′52″ W; 171 m; 3 Dec. 2007; *G. McPherson & H. van der Wer 19950* (MO, PMA); *ibid.*, forest along ridge road; 08°49′22″ N, 080°39’32” W; 300 m; 25 Feb. 2008; *G. McPherson & M. Merello 20248* (MO, PMA); ibid., forest along río Caimito; 09°00′25″ N, 080°41′03″ W; 5 m; 2 Mar. 2008; *G. McPherson 20426* (MO, PMA); Site of proposed copper mine (MPSA), forested slopes; 08°48′27″ N, 080° 36′20″ W; 100 m; 13 Dec. 2009; *G. McPherson & M. Merello 21289* (MO, PMA). Figure 4A.

Global distribution. Brazil, Colombia, French Guiana, Guyana, Panama, Peru, Suriname, and Venezuela.

Identi ication. *Taralea oppositifolia* is characterized by having glabrous leaflets with inconspicuous venation on upper surfaces and flowers with upper lip of calyx coriaceous and a densely pilose ovary (Lima and Aymard 1999). *Taralea oppositifolia* represents the first record of the genus in Central America.

Zygia conzattii (Standl.) Britton & Rose, N. Amer. Fl. 23: 40 (Britton and Rose 1928).
(≡) *Calliandra conzattii* Standl., Contr. U.S. Natl. Herb. 20, 1919.

New records. Colón. Teck Cominco Petaquilla mining concession, forest; 08°55′53″ N, 080°40′08″ W; 80 m; 24 Jun. 2008; *G. McPherson 20625* (MO, PMA). Figure 4A.

Global distribution. Belize, Costa Rica, Mexico, and Panama.

Identi ication. This species is distinguished by its leaves with three or five subcoriaceous leaflets per pinna, elliptic to broadly elliptic or asymmetric-oblong leaflets, sessile whitish flowers and relatively narrow (1–1.5 cm) fruits. *Zygia conzattii* could be confused with *Z. latifolia* (L.) Fawc. & Rendle, which differs in having straight and broader fruits (1.5–3.3 cm wide) and leaflets typically with all secondary veins more or less patent to slightly ascending (vs leaflets usually with two or three second-ary veins strongly ascending in *Z. conzattii*) (Zamora 2010).

GENTIANACEAE

Tachia parvi lora Maguire & Weaver, J. Arnold Arbor. 56: 123 (Maguire and Weaver 1975).
Figure 1F

New records. Coclé. Camino al Alto Tífe; 08°42′56″ N, 080°37′45″ W; 383 m; 24 Jan. 2013; *N. Jaén et al. 112* (PMA); Parque Nacional Omar Torrijos, bosque cercano al Río Tífe, entrando por los terrenos del Sr. Ife Quiróz; 08°42′22″ N, 080°38′03″ W; 483 m; 17 Jul. 2013; *A. Zapata et al. 3184* (PMA). **Colón.** Distrito de Donoso, campamento Petaquilla hacia Valle Grande, en dirección 13° SE; 3 Jul. 1996; *A. Zapata et al. 983* (PMA); Área del proyecto minero Petaquilla; 6 Dec. 2007; *B. Araúz & J. Meerman 1428B* (PMA); ibid.; 6 Jan. 2007; *B. Araúz & P. Moreno 1505* (PMA); Proposed copper mining site; *Araúz 1428* (MO, PMA); Teck Cominco Petaquilla mining concession, forest; 08°49′06″ N, 080°41′02″ W; 180 m; 22 Jun. 2008; *G. McPherson 20594* (MO, PMA); Área de concesión del Proyecto Minera Cobre Panamá S.A., Valle Grande; 08°50′01″ N, 080°41′10″ W; 171 m; 16 Sept. 2014; *I. Vergara-Pérez 1012* (PMA). Figure 4B.

Global distribution. Bolivia, Colombia, Costa Rica, Panama, and Peru.

Identification. This species is easily distinguished from all other *Tachia* species by the combination of the following characters: small corollas, frequently branched and terete stems, and arcuate leaves (Struwe and Kinkade 2013). *Tachia parviflora* is the only representative of the genus in Central America (previously reported in Costa Rica) (Davidse 2009).

LACISTEMATACEAE

Lozania glabrata A.H. Gentry, Ann. Missouri Bot. Gard. 75: 1431 (Gentry 1988).

New records. Colón. Teck Cominco Petaquilla mining concession, ridgetop forest along road; 08°49′28″ N, 080°39′29″ W; 190 m; 21 Sept. 2007; *G. McPherson 19768* (MO); ibid.; 08°49′18″ N, 080°39′35″ W; 255 m; 28 Nov. 2007; *G. McPherson & H. van der Werff 19857* (MO); ibid., forested slopes; 08°50′17″ N, 080°38′52″ W; 171 m; 3 Dec. 2007; *G. McPherson & H. van der Werff 19941* (MO); ibid., Colina camp, forested slopes along road; 08°49′23″ N, 080°39′32″ W; 101 m; 26 Feb. 2008; *M. Merello et al. 3063* (MO); ibid., forest in proposed tailings area, 08°51′09″ N, 080°39′05″ W; 150 m; 19 Jun. 2008; *G. McPherson 20530* (MO); Botija, carretera Pionera, lowland wet rain forest; 08°50′06″ N, 080°39′17″ W; 10 Sept. 2012, *H. van der Werff et al. 24429* (MO). Figure 4B.

Global distribution. Colombia and Panama.

Identification. According to Gentry (1988), *L. glabrata* is easily the most distinctive species of the genus by its glabrous leaves and sub-entire blade margins and differs from all its congeners by having stamens with the filament deeply split at the apex (which gives the illusion of two stamens).

LAURACEAE

Ocotea aciphylla (Nees & Mart.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 243 (Mez 1889).
(≡) *Oreodaphne aciphylla* Nees & Mart., Linnaea 8, 1833.

New records. Colón. Minera Panamá, Brazo; 08°48′

48″ W, 080°38′08″ W; 271 m; 26 Sept. 2014, *C. Ramos 331* (PMA, MO). Figure 4B.

Global distribution. Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname, and Venezuela.

Identification. This species is characterized by having terete, pubescent and solid branches, a canaliculate petiole, an elliptic or narrowly elliptic-ovate blade (1–2 times longer that wide) that is strongly recurved at base, pedicels 3– 7 mm long, short inflorescences (2–10 cm long) with sericeous-pubescent flowers and relative long fruits (to 3 cm long) (Allen 1964; Vásquez 1997). Based on decurrent base blades and pubescent bisexual flowers, *O. aciphylla* could be confused with *O. insularis* (Meissner) Mez, but the latter species differs in having broadly elliptic to obovate or oblong blades, longer inflorescences (7–22 cm long) and smaller fruits (1–1.8 cm long) (González-Ramírez and Poveda 2007).

Pleurothyrium glabritepalum van der Werff, Ann. Missouri Bot. Gard. 80: 75 (van der Werff 1993).

New records. Veraguas. Área del río Guayabalito, bosque secundario maduro, trocha que conduce a la comunidad de Calle Larga; 08°44′10″ N, 080°46′59″ W; 387 m; 22 Mar. 2014; *L. Martínez et al. 1776* (MO, PMA). Figure 4B.

Global distribution. Colombia, Ecuador, and Panama.

Identification. According to van der Werff (1993), the useful characters to identify *P. glabritepalum* are the following: the more or less erect pubescence, which is also present on the upper leaf surface, the gland dots on the upper leaf surface, the alternate, acuminate thin-textured leaves, the few-flowered inflorescences, and the glabrous inner surface of the unequal tepals. This species is most similar to *P. triflorum* van der Werff, which differs in having equal tepals with the inner surface densely gray papillose and blades glabrous on the abaxial surface (van der Werff 2009).

MALPIGHIACEAE

Byrsonima garcibarrigae Cuatrec., Webbia 13: 621 (Cuatrecasas 1958).
Figure 2E

New records. Coclé. Parque Nacional G.D. Omar Torrijos Herrera, área boscosa en las proximidades del río Cano Sucio; 08°43′00″ N, 080°36′41″ W; 245 m; 25 Jul. 2013; *A. Zapata 3319b* (MO, PMA); ibid., Distrito de La Pintada, correg. El Harino, bosque cercano al río Tife; 08°43′18″ N, 080°37′56″ W; 247 m; 20 Jul. 2013; *A. Zapata 3243* (MO, PMA); ibid., Caño Sucio, área del Tífe, bosque húmedo; 08°43′18″ N, 080°37′56″ W; 247 m; 20 Jul. 2013; *O. Ortiz et al. 1420* (MO, PMA); ibid., Río San Juan, colectada cercano a la desembocadura del río Escobal; 08°43′24″ N, 080°40′05″ W; 143 m; 20 Jul. 2013; *L. Martínez 1325* (MO, PMA); ibid., área de Calle Larguita (Palmarazo), ribera del Río San Juan (cerca del campamento), bosque primario ribereño; 08°43′20″ N, 080°40′23″ W; 140 m; 20 Jul. 2013; *A. Espinosa 6168* (MO, PMA). **Colón**. Teck Cominco Petaquilla mining concession, forest near helipad; 08°50′16″ N, 080°39′17″ W; 160 m; 21 Jun. 2008; *G. McPher-son 20576* (MO); MPSA Concession, Valle Grande; 08°49′ 31″ N, 080°40′11″ W; 291 m; 18 May 2012; *B. Hammel 26241* (MO); Donoso, San Juan del General, concesión del Proyecto Mina de Cobre Panamá, Brazo, bosque secundario maduro; 08°48′32″ N, 080°38′36″ W; 245 m; 9 Jul. 2014; *J. De Gracia 787* (MO, PMA); Área de concesión del Proyecto Minera Cobre Panamá S.A., antiguo campamento de Botija; 08°50′19″ N, 080°38′55″ W; 170 m; 4 Jun. 2014; *I. Vergara-Pérez 541* (MO, PMA); MPSA, sendero Botija, detrás vivero FCD, cerca de quebrada Botija y río Botija; 08°50′12″ N, 080°38′41″ W; 117 m; 24 May 2015; *J. Batista 1370* (MO, PMA); Proyecto Minera Cobre Panamá, Botija, parcela interpretativa de restauración ecológica 2.5, sierra 1; 08° 48′59″ N, 080°39′11″ W; 237 m; 31 Mar. 2016; *I. Vergara-Pérez 1083* (MO, PMA); ibid., camino hacia cantera Botija; 08°50′32″ N, 080°39′18″ W; 178 m; 11 May 2014; *I. Vergara-Pérez 447* (MO, PMA); ibid., Botija, send-ero detrás del vivero de plantas de MPSA; 08°49′43″ N, 080° 39′12″ W, 167 m; 29 Apr. 2014, *I. Vergara-Pérez 380* (MO, PMA). **Comarca Ngäbe-Buglé**. Río Caña, finca de Patricia Robinson; 09°01′06″ N, 081°43′26″ W; 30 m, 14 May 2014; *A. Ibáñez et al. 8925AI* (PMA). Figure 4B.

Global distribution. Brazil, Colombia, Panama, and Peru.

Identi ication. *Byrsonima garcibarrigae* is characterized by having papery, narrowly elliptic leaves with long petioles to 2 cm long, white or pink flowers with puberulent pedicels only 5–6 mm long, and outer anther locules flattened and alate with the connective shorter than the locules and blunt. This species is related to *B. dressleri* W.H. Lewis, which differs in having obovate coriaceous leaves, shorter petioles (1 cm long), longer (7–10 mm long) pinkish pedicels, and outer anther locules non-alate and cylindrical with the connective equaling the locules (Lewis 1973).

MALVACEAE

Pentaplaris doroteae L.O. Williams & Standl., Ceiba 3: 140 (Williams and Standley 1952).

New records. Colón. Donoso, Teck Cominco Petaquilla mining concession, slope, collected near plot C003; 08° 50′22″ N, 080°38′51″ W; 184 m; 18 Sept. 2007; *G. McPher-son 19661* (MO). Figure 4C.

Global distribution. Colombia, Costa Rica, and Panama.

Identi ication. This species is easily distinguished from two other *Pentaplaris* species by the combination of the following characters: leaf blades with stellate-pubescence below, the hairs multi-rayed stellate, cordate, asymmetrical to strongly asymmetrical at base, obovoid to pyriform flower buds and fruit with calyx ca 2–3.5 cm long (Bayer and Dorr 1999).

MARATTIACEAE

Danaea grandifolia Underw., N. Amer. Fl. 16: 18 (Underwood 1909).

New records. Coclé. Parque Nacional G.D. Omar Torrijos Herrera, área boscosa en las proximidades del río Guabal, aguas arriba, ribera izquierda, terrenos colindantes con la propiedad del Sr. Santos Navas; 08°42′19″ N, 080°35′16″ W; 378 m; 24 Jul. 2013; *A. Zapata 3309* (MO, PMA); ibid., La Rica, bosque cercano al río Juan Julio, bosque húmedo con presencia de muchas quebradas; 08°42′43″ N, 080°35′30″ W; 200 m; 22 Jul. 2013; *O. Ortiz et al. 1453* (MO, PMA); **Colón.** Donoso, Coclé del Norte, Minera Panamá, helipat C01; 08°58′24″ N, 080°42′22″ W; 130 m; 9 Mar. 2010; *A. Espinosa et al. 5527* (MO, PMA); Teck Cominco Petaquilla mining concession, forest in proposed tailings area; 08°51′09″ N, 080°39′05″ W; 155 m; 19 Jun. 2008; *G. McPherson 20527* (MO); Coclé del Norte, área del helipad Escorpio 02, tomando la ruta sur; 08°55′31″ N, 080°40′09″ W; 39 m; 21 Jul. 2012; *A. Espinosa et al. 6021* (MO, PMA); Coclé del Norte, Minera Panamá, helipad C02; 08°56′37″ N, 080°44′00″ W; 134 m; 16 Mar. 2010; *A. Espinosa et al. 5719* (MO, PMA); ibid., área del helipad C15, bosque húmedo tropical; 18 Mar. 2010; *A. Zapata et al. 2554* (MO, PMA); ibid., Minera Panamá, helipad C02; 08°56′58″ N, 080°43′52″ W; 131 m; 14 Mar. 2010; *A. Espinosa 5670* (MO, PMA); ibid., área del helipad C11, bosque húmedo tropical; 08°57′54″ N, 080°37′01″ W; 12 Mar. 2010; *A. Zapata & J.I. González 2545* (MO, PMA). Figure 4C.

Global distribution. Colombia, Dominican Republic, Haiti, Panama, Puerto Rico, and Venezuela.

Identification. Underwood (1909) described *Danaea grandifolia*, as a taxon related to *D. nodosa* (L.) Sm., and reported it from Colombia (type from Valparaiso, Santa Marta) and Panama (without citing a Panamanian specimen). Rolleri (2004) synonymized *D. grandifolia* under *D. nodosa*, arguing that the type material of *D. grandifolia* corresponded to well-developed specimens of *D. nodosa*. However, Christenhusz (2010) recognized that *D. grandifolia* is restricted to South America and distinct from *D. nodosa*. According to Christenhusz (2010), *D. grandifolia* is distinguished by the combination of the following characters: terrestrial plants, creeping rhizomes with several rows of leaves, these placed more or less radially and the roots all on the lower side; leathery or transparent blades, always with normally developed terminal pinnae (never replaced by bulbils), iridescent (when juvenile); entire pinna margins (sometimes slightly sinuate at apex). *Danaea grandifolia* could be confused with *D. nodosa*, which differs in having dentate, denticulate, serrate, serrulate or crenulate pinna margins.

MELASTOMATACEAE

Blakea dimorphophylla (Almeda) Penneys & Almeda in Penneys and Judd, PhytoKeys 20: 25 (Penneys and Judd 2013).

(≡) *Topobea dimorphophylla* Almeda, Proc. Calif. Acad. Sci., 4th Ser. 55, 2001.

New records. Colón. Minera Panamá, north waste dump, plant site; 08°51′20″ N, 080°38′24″ W; 143 m; 24 Oct. 2014; *C. Ramos 366* (MO, PMA). Figure 4C.

Global distribution. Costa Rica and Panama. Monro et al. (2017) reported this species in Panama; however, they did not cite any representative specimens from Panama.

Identification. This species is characterized by having leaf blades markedly unequal in size at each node, densely pubescent on both surfaces and basally fused floral bracts (Almeda 2001). *Blakea dimorphophylla* is similar to *B. intricata* (Almeda) Penneys & Almeda, but the latter differs in having slightly unequal leaf blades and free floral bracts (Almeda 2009).

Henriettea odorata (Markgr.) Penneys, Michelang., Judd & Almeda, Syst. Bot. 35: 798 (Penneys et al. 2010).

(≡) *Henriettella odorata* Markgr., Notizbl. Bot. Gart. Berlin-Dahlem 15, 1941.

New records. Colón. Teck Cominco Mining Concession, Camp Colina, forested slopes along road; 08°49′30″ N, 080°40′11″ W; 298 m; 1 Mar. 2008; *M. Merello & J.I. González 3160* (MO); ibid., forest near helipad; 08°50′16″ N, 080°39′17″ W; 160 m; 21 Jun. 2008; *G. McPherson 20574* (MO). Figure 4C.

Global distribution. Colombia, Costa Rica, Ecuador, Nicaragua, and Panama.

Identification. *Henriettea odorata* is recognized by its essentially glabrous leaf blades on both surfaces, glabrous pedicels (in fruits) and consistently tetramerous flowers with unguiculate petals. This species is similar to *H. fascicularis* (Sw.) C. Wright, which differs in having sparsely setulose blades on upper surfaces, oblong anthers and minutely glandular-puberulent fruiting pedicels (Almeda 2007, 2009).

Miconia paleacea Cogn., Monogr. Phan. 7: 757 (Cogniaux 1891).
Figure 2B

New records. Bocas del Toro. Changuinola, Bosque Protector Palo Seco, Río Changuinola arriba, Charco La Pava, bosque trasero de la casa del señor Reynaldo Abrego; 09°09′31″ N, 082°30′35″ W; 424 m; 3 Feb. 2013, *O. Ortiz et al. 1214* (PMA); ibid., comunidad de Guayacán, 09°08′22″ N, 082°29′47″ W; 232 m; 4 Feb. 2014; *O. Ortiz & C. Galdames 2089* (PMA, SCZ). Figure 4C.

Global distribution. Belize, Brazil, Colombia, Ecuador, Honduras, Nicaragua, Panama, Peru, and Venezuela.

Identification. This species is distinguished by the combination of the following characters: distal twigs with trichomes basally flattened and reflexed, petioles and basal portions of the elevated nerves on lower surfaces of the blades usually stained red-purple, and by its large leaves abruptly acuminate at the apex and inflorescences moderately to densely covered by reflexed rigid, basally flattened hairs, with these underlaid by soft

woolly interwoven hairs (Almeda 2007). Both *Miconia paleacea* and *M. calvescens* DC. have purple-red blades beneath, but the latter differs in having inflorescences and hypanthium moderately covered by late-deciduous stellate hairs (Almeda 2009).

MORACEAE

Ficus donnell-smithii Standl., Contr. U.S. Natl. Herb. 20: 21 (Standley 1917).

New records. Colón. Site of proposed copper mine (MPSA), forested slopes; 08°50′13″ N, 080°37′04″ W; 70 m; 11 Dec. 2009; *G. McPherson & M. Merello 21269* (MO, PMA). Figure 5A.

Global distribution. Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Panama, Peru, Suriname, and Venezuela.

Identification. This species is recognized by its densely pubescent stipules, lanceolate to narrowly oblong leaf blades with glandular dots in the axils of the basal lateral veins and pedunculate figs (arranged in pairs) (Standley 1917; González-Ramírez 2007). *Ficus donnell-smithii* is vegetatively similar to *F. yoponensis* Desv., which differs in having oblong-elliptic to very narrowly oblong or lanceolate-oblong blades with glandular dots at the base of mid-veins and a solitary fig.

MYRTACEAE

Calyptranthes bracteata M.L. Kawas. & B. Holst, Brittonia 46: 137 (Kawasaki and Holst 1994).
Figure 2D

New records. Colón. Coclé del Norte, área del helipad CR10, tomando hacia el oeste; 08°56′40″ N, 080°42′28″ W; 19 Jul. 2012; *J. Aranda 4251* (MO, PMA); ibid, Minera Panamá, helipad H55; 08°51′38″ N, 080°41′34″ W; 85 m; 12 Dec. 2010; *A. Espinosa 5842* (MO, PMA); ibid, helipad H55; 08°51′37″ N, 080°41′34″ W; 95 m; 12 Dec. 2010; *A. Espinosa 5838* (MO, PMA); ibid., área del helipad TO2A, caminando hacia la ruta oeste; 08°53′38″ N, 080°40′44″ W; 130 m; 19 Jul. 2012; *A. Espinosa 6006* (MO, PMA); ibid., área del helipad TO2A, caminando hacia la ruta norte; 08°53′38″ N, 080°40′44″ W; 130 m; 17 Jul. 2012; *A. Espinosa 5987* (MO, PMA); ibid., área del helipad BE03 (río Escribano), tomando la ruta norte; 08°52′17″ N, 080°50′56″ W; 52 m; 25 Jul. 2012; *A. Espinosa 6065* (MO, PMA); ibid., *A. Espinosa 6066* (MO, PMA); Teck Cominco Petaquilla mining concession, forest near helipad; 08°49′12″ N, 080°40′52″ W; 190 m; 22 Jun. 2008; *G. McPherson 20591* (MO); ibid., área del Helipad T02A, tomando la ruta Sur, a orilla de una trocha; 08°53′20″ N, 080°40′26″ W; 143 m; 18 Jul. 2012; *L. Martínez 870* (MO, PMA); ibid., área del río Escribano, cercano al río Belén límite de la Provincia de Colón y Veraguas; 08°52′17″ N, 080°51′04″ W; 37 m; 25 Jul. 2012; *L. Martínez 928* (MO, PMA). Figure 5A.

Global distribution. French Guiana and Panama.

Identification. *Calyptranthes bracteata* differs from all other species in the genus by the short, few flowered, brown-tomentose inflorescences with large, persistent bracts and elliptic to narrowly elliptic (12–20 × 3.5–8 cm), coriaceous leaf blades. Based on tomentose inflorescences, *Calyptranthes bracteata* is similar to *C. elliptica* B. Holst & M.L. Kawas., which differs in having broadly elliptical to elliptical (4–9.4 × 3.1–7 cm) chartaceous leaf blades and deciduous bracts (Kawasaki and Holst 1994).

Eugenia albicans (O. Berg) Urb., Bot. Jahrb. Syst. 19: 617 (Urban 1895).
(≡) *Stenocalyx albicans* O. Berg, Linnaea 30, 1860.

New records. Colón. Teck Cominco Petaquilla mining concession, ridgetop forest along road; 08°49′18″ N, 080°39′35″ W; 255 m; 28 Nov. 2007; *McPherson & van der Werff 19848* (MO); ibid., forest on slope; 08°49′08″ N, 080°37′14″ W; 100 m; *G. McPherson & H. van der Werff 20063* (MO); ibid., forested slopes along ridge road; 08°49′51″ N, 080°40′55″ W; 250 m; *G. McPherson 20469* (MO); Minera Panamá, Valle Grande, Sierra 18, sendero de CABO hacia plataformas; 08°50′06″ N, 080°40′43″ W; 303 m; 9 Oct. 2014, *C. Ramos 348* (MO, PMA). Figure 5A.

Global distribution. Brazil, Caribbean (Leeward Islands, Trinidad and Tobago, Windward Islands), French Guiana, Guyana, Panama, and Suriname.

Identification. This species is recognized by having markedly bicolorous oblong-lanceolate blades which are smooth and lustrous above and very pale or glaucous on the lower surfaces; long appressed bright coppery silky hairs that cover the inflorescences and flowers and long (3–4 mm long) thin-textured, glabrous (internally) and broadly hooded calyx-lobes that cover the corolla in bud (McVaugh 1969). *Eugenia albicans* is vegetatively similar to *E. coibensis* Barrie (both have greyish blades when dry), but the latter differs in having ovate, elliptic or obovate leaf blades and elliptic petals and sepals.

OCHNACEAE

Ouratea rinconensis Whitef., Novon 2: 277 (Whitefoord 1992).

New records. Colón. Coclé del Norte, Minera Panamá, helipad C22; 08°50′37″ N, 080°45′35″ W; 120 m; 20 Oct. 2010; *A. Espinosa 5784* (MO, PMA); Coclé del Norte, Minera Panamá, helipad H02; 08°56′13″ N, 080°40′21″ W; 54 m; 15 Dec. 2010; *A. Espinosa 5893* (MO, PMA); Coclé del Norte, helipad C10, a orillas del río Belencillo, bosque secundario intervenido; 08°48′25″ N, 080°43′18″ W; 117 m; 21 Oct. 2010; *L. Martínez 654* (MO, PMA); Coclé del Norte, helipad CR15W; 08°55′26″ N, 080°40′37″ W; *L. Martínez 708* (PMA); Westernmost part of province, site of proposed copper mine (INMET), lowland forest in Tailings Area; 08°53′16″ N, 080°39′15″ W; 65 m; 10 Apr. 2009; *G. McPherson & Jean-Yves Serein 20833* (MO); Coclé del Norte, área de concesión

Minera Panamá; 08°54′37″ N, 080°35′30″ W; *O. Ortiz 76* (MO, PMA); Coclé del Norte, bosque húmedo tropical, área del helipad C14; 08°48′49″ N, 080°46′29″ W; 63 m; 21 Oct. 2010; *A. Zapata 2588* (MO, PMA); Área de concesión del Proyecto Minera Cobre Panamá S.A., Valle Grande, antiguo sendero de reubicación de flora; 08°49′21″ N, 080°39′58″ W; 260 m; 16 Aug. 2014; *I. Vergara-Pérez 770* (MO, PMA). Figure 5A.

Global distribution. Costa Rica and Panama.

Identification. This species is recognized by its leaf blades with the secondary nerves regularly spaced, conspicuously elevated on lower surface, racemose inflorescences and flowers with two sepals (Morales 2007). *Ouratea rinconensis* Whitef. is most similar to *O. flexipedicellata* Dwyer, which differs mainly in having five sepals (Whitefoord 1992).

ORCHIDACEAE

Sobralia purpurella Dressler & Bogarín, Orchids (West Palm Beach) 80: 309 (Dressler and Bogarín 2011).
Figure 2F

New records. Bocas del Toro. Bosque Protector Palo Seco, sendero El Verrugoso; 08°46′46″ N, 082°10′14″ W; 802 m; 6 Feb. 2013; *O. Ortiz et al. 1243* (PMA, UCH). Figure 5A.

Global distribution. Costa Rica and Panama.

Identification. *Sobralia purpurella* is distinguished by the following characters: lanceolate-elliptic leaf blades of 15–30 × 1.9–3 cm; inflorescence terminal on leafy stems and also on short, leafless stems; flowers with white sepals, pale pink to purplish petals with an intensely purple lip (blood red within), undulate and emarginated. In Panama, *S. purpurella* is most similar to *S. leucoxantha*, but the latter has leafless inflorescences usually about as long as the leafy stems (Dressler and Bogarín 2011).

PASSIFLORACEAE

Passiflora macrophylla Spruce ex Mast., J. Linn. Soc. Bot. 20: 31 (Masters 1883).
Figure 2H

New records. Darién. Pueblo de Bahía Piñas; 7°34′57″ N, 078°10′40″ W; 46 m; 29 Jun. 2015; *A. Jiménez 268* (MO, PMA); Área de Manejo Especial de Bahía Piñas, bosque cercano a Aceite; 7°37′41″ N, 078°11′10″ W; 87 m; 30 Jun. 2018; *O. Ortiz et al. 2907* (PMA). Figure 5B.

Global distribution. Colombia, Ecuador, and Panama.

Identification. *Passiflora macrophylla* is recognized by the following characters: weak tree, to 5 m high, stipules setaceous to triangular, absence of tendrils, leaf blade unlobed, subpeltate, usually 40–81 cm long. Peduncles dichotomously or trichotomously branched 1–3 times, 2–12 (–17) flowered, 8–25 cm long. Flowers white inside, tinged pale green outside (Vanderplank et al. 2017). Currently in Panama there are two other species that may present arboreal habit, *P. tica* Gómez-Laur. & L.D. Gómez and *P. pittieri* Mast. These two species differ from *P. macrophylla* in having smaller blades (up to 50 cm long) and a densely tomentose ovary (vs glabrescent in *P. macrophylla*).

PERACEAE

Pera oppositifolia Griseb., Nachr. Königl. Ges. Wiss. Georg-Augusts-Univ. 1: 181 (Grisebach 1865).

New records. Chiriquí. Cerro Batipa; 08°21′27″ N, 082°14′31″ W; 26 m; 5 Dec. 2003; *R. Pérez 1159* (PMA). Figure 5B.

Global distribution. Costa Rica, Cuba, and Panama.

Identification. It is recognized by its opposite leaves, blades with anastomosing secondary veins which form several submarginal veins, densely covered with lepidote indumentum on the lower surface (González-Ramírez 2010). *Pera oppositifolia* represents the second species of this genus in Panama; previously there were only records of *P. arborea* Mutis (Correa et al. 2004). The latter species differs from *P. oppositifolia* mainly in having alternate leaves.

POACEAE

Digitaria costaricensis R. Pohl, Fieldiana, Bot. 38: 5 (Pohl 1976).

New records. Chiriquí. Playa La Barqueta, cerca al arrozal localizado a 200 m de la playa; *J. Polanco 2836* (PMA). Figure 5B.

Global distribution. Costa Rica, Guatemala, and Panama. Recent data from Mexico (Sánchez-Ken 2017) and El Salvador (Baldini and Menjívar, in progress) suggest a more widespread presence of this species in Central America.

Identification. This species is distinguished by having velutinous leaf blades, non-winged racemes and long spikelets (3.5–4.2 mm), unbranched lower racemes, grayish superior lemma and 5–7-ribbed superior glume (Pohl and Davidse 1994). *Digitaria costaricensis* is morphological similar to *D. aequiglumis* (Hack. & Areche.) Parodi, which differs from *D. costaricensis* in having densely pubescent foliage, wider leaf blades, a cuff-like first glume on the spikelet, and longer racemes up to 14 cm. The record from Panama seems to be similar to those from Costa Rica, because it presents long racemes, reduced upper flowers, and inferior lemma with large nerves.

Lasiacis ligulata Hitchc. & Chase, Contr. U.S. Natl. Herb. 18: 337 (Hitchcock and Chase 1917).

New records. Bocas del Toro. Bosque Protector Palo Seco, río Changuinola arriba, Charco La Pava, bosque trasero de la casa del señor Reynaldo Abrego; 09°09′31″ N, 082°30′35″ W; 424 m; 3 Feb. 2013; *O. Ortiz et al. 1216* (FT, PMA); Changuinola, Bosque Protector Palo Seco, Charco La Pava, Comunidad de Guayacán; 09°09′31″ N,

082°30′35″ W; 424 m; 4 Feb. 2014; *O. Ortiz & C. Galdames 2105* (FT, PMA). **Coclé.** Región de El Copé, Parque Nacional Omar Torrijos Herrera, centro de visitantes, sendero la rana dorada; 08°40′05″ N, 080°35′34″ W; 750–790 m; *C. Galdames 5901* (PMA, SCZ). Figure 5B.

Global distribution. Bolivia, Brazil, Colombia, Dominican Republic, Ecuador, French Guiana, Guyana, Panama, Peru, Puerto Rico, Suriname, West Indies and Venezuela. The specimens cited here represent the first records of this species for Central America.

Identification. According to Davidse (1978), this species is distinguished by having erect stems, hollow or partially hollow culms, conspicuous ligules of the upper leaves (usually 2–3 mm long), small blades (usually 7–14 cm long and 1.0–2.2 cm wide), not conspicuously cordate; small inflorescences (2–21 cm long), long ovoid panicles (usually 2–17 cm long), completely exserted at the base. Specimens from Panama match the type material from Trinidad (Hitchcock and Chase 1917). This species is most closely related to *L. maculata* (Aubl.) Urb. [= *L. sorghoidea* (Desv.) Hitchc. & Chase var. *sorghoidea*] from which differs in its less dense and reflexed branches, scanty blade pubescence, and longer membranous ligules.

Lasiacis sloanei (Griseb.) A. Hitchc., Bot. Gaz. 51: 302 (Hitchcock 1911).

(≡) *Panicum sloanei* Griseb. Flora of the British West Indian Islands, 1864.

New records. Panamá Oeste. Parque Nacional Altos de Campana, carretera a Chicá; 08°41′13″ N, 079°55′00″ W; 2 Feb. 2013; *M. de Stapf & R. Baldini 939* (PMA); ibid., orillas de la carretera a Chicá, después del mirador; 08°41′22″ N, 079°54′54″ W; 624 m; 16 Jun. 2013; *M. de Stapf & D. Stapf 1073* (PMA). Figure 5B.

Global distribution. Cuba, Haiti, Dominican Republic, Belize, Caribbean, Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador. An old specimen was found at the herbarium MA, collected by L. Neé ("Panama, *Neé s.n.*", MA) during the A. Malaspina's expedition around the World (Baldini unpubl. data).

Identification. *Lasiacis sloanei* has a caespitose, clambering, or climbing culm. It is characterized by glabrous sheaths and blades that are broad (usually 1.7–4.0 cm wide), shiny, and glabrous except for a line of puberulence or scabridity along the midrib on the upper surface. This species also has a collar that is densely puberulent or hispid, and the inflorescence is sparsely flowered with large spikelets (usually 4.3–4.8 cm long) born on short pedicels appressed to the panicle branches (Davidse 1978). This species belong to the Caribbean and Mesoamerican *Lasiacis* group and is closely related to *L. divaricata* (L.) Hitchc. The latter species differs from *L. sloanei* in having a zigzag pattern of branching, shorter and narrower leaves, smaller spikelets, culm without adventitious roots, and reflexed panicle branches (generally at maturity).

PORTULACACEAE

Portulaca papillato-stellulata (Danin & H.G. Baker) Danin in Danin and Reyes-Betancort, Lagascalia 26: 76 (Danin and Reyes-Betancort 2006).

(≡) *Portulaca oleracea* L. subsp. *papillato-stellulata* Danin & H.G. Baker, Israel J. Bot. 27, 1978.

Figure 1G

New records. Comarca Guna Yala. Isla de Ailigandi; 09°13′40″ N, 078°01′40″ W; 4 m; 20 Jan. 2013; *O. Ortiz & R. Baldini 1129* (FT, PMA). Figure 5B.

Global distribution. Guatemala, Mexico, Liberia, Panama, and United States.

Identification. Danin et al. (1978) stated that the seed coat characters, seed size and chromosome numbers are constant diagnostic characters within the *Portulaca oleracea* L. polyploid complex. Danin and Reyes-Betancort (2006) reviewed the complex and proposed raising some of its subspecies to specific rank, which were subsequently included in the treatment developed by Danin and Raus (2012). *Portulaca papillato-stellulata* (2n = 54) is characterized by having seeds of 0.9 × 0.8 mm, star-shaped testa cells and long rays with terminal papillae (Rodríguez-Navarro et al. 2009; Danin and Raus 2012). *Portulaca papillato-stellulata* and *P. oleracea* are morphologically very similar (when sterile, almost undistinguishable from each other). However, when in fruit, *P. oleracea* differs in having smooth testa cells.

RANUNCULACEAE

Clematis populifolia Turcz., Bull. Soc. Imp. Naturalistes Moscou 27: 272 (Turczaninow 1854).

New records. Chiriquí. Vicinity of Fortuna Dam. along trail across valley south of lake, forest; 08°45′04″ N, 082°15′04″ W; 1400 m; 28 Dec. 1986; *G. McPherson & J. Aranda 10204* (MO). Figure 5C.

Global distribution. Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Nicaragua, Panama, and Venezuela.

Identification. It is recognized by its 3-foliolate leaves with membranous entire leaflets, inflorescences usually with umbellate ultimate nodes and 8–25 carpels (Moreno 1993). According to Moreno (1993), *Clematis populifolia* has long been included within *C. haenkeana* C. Presl, but the latter differs in having 20–50 carpels and five-foliolate leaves.

SALICACEAE

Hasseltia lateriflora Rusby, Descr. S. Amer. Pl. 62 (Rusby 1920).

Figure 1E

New records. Darién. Serranía del Majé, Cerro Chucantí, sendero al helicóptero; 08°47′50″ N, 078°27′42″ W; 900 m; 3 Mar. 2011; *R. Flores et al. 574* (PMA). Figure 5C.

Global distribution. Colombia, Ecuador, and Panama.

Identification. *Hasseltia lateriflora* is distinguished

from the other species by having leaves with short petioles (usually 0.5–3.5 cm long), elliptic, obovate, or rarely subovate blades, inflorescences terminal and also axillary from the upper 3–5 leaf axils, usually 5–9 branches or flowers per umbel, flowers with white-villous staminal filaments and numerous disk lobes. This species is similar to *H. guatemalensis* Warb., which differs in having terminal inflorescences with usually 3–5 branches or flowers per umbel and few disk lobes (fewer than 16 lobes) (Alford 2006).

SAPINDACEAE

Vouarana anomala (Steyerm.) Acev.-Rodr., BioLlania, Ed. Espec. 6: 146 (Acevedo-Rodríguez 1997).
(≡) *Toulicia anomala* Steyerm., Ann. Missouri Bot. Gard. 75, 1988.

New records. Panamá. Cerro Jefe, antes del desvío hacia Altos de Pacora; 09°12′46″N, 079°22′41″W; 500 m; 7 Sept. 2007; *FLORPAN et al. 7192* (PMA). Figure 5C.

Global distribution. Costa Rica, Colombia, Ecuador, Panama, Suriname, and Venezuela.

Identification. This species is distinguished by its arboreal habit, pinnately compound leaves, leaflets with domatia on the lower surface (along mid-veins) and flowers with four sepals and petals. Currently, *Vouarana* comprises only two Neotropical species, and *V. anomala* is the only representative of the genus in Central America (previously reported in Costa Rica) (Morales 2015).

SAPOTACEAE

Pouteria bulliformis Q. Jiménez & T.D. Penn., Novon 7: 169 (Jiménez-Madrigal and Pennington 1997).

New records. Colón. Quebrada López; 09°19′27″ N, 079°47′58″ W; 10 Jun. 2003; *R. Pérez & I. Tejada 1049* (PMA); Río Palenque, Nueva Providencia; 09°17′9.60″ N, 079°47′38.78″ W; 23 Aug. 2003; *A. Somoza et al. 114* (PMA); Nueva Providencia, cuenca del río Palenque; 09°16′19″ N, 079°47′48″ W; 57 m; 2 Oct. 2003; *R. Pérez et al. 1138* (PMA). **Panamá.** Parque Nacional Chagres, Cerro Jefe, sendero de las Pentagonias; 09°12′40″ N, 079°22′41″ W; 750 m; 3 Jan. 2001; *R. Aizprúa et al. B2528* (MO); San Juan de Pequení; 09°23′49″ N, 079°31′35″ W; 200 m; 25 Mar. 1998; *S. Aguilar et al. 979* (PMA). Fig-ure 5C.

Global distribution. Colombia, Costa Rica, Nicaragua, and Panama.

Identification. This species is characterized by having densely ferruginous-tomentose young shoots and inflorescences, bullate blades, rounded apically (sometimes short cuspidate) and tomentose (at least on the veins) on lower surfaces. *Pouteria bulliformis* is similar to *P. simulans* Monach., but the latter differs in having short-pubescent young shoots and inflorescences, non-bullate blades, narrowly short-attenuate apically that are somewhat glabrous on lower surfaces (Jiménez-Madrigal and Pennington 1997).

SOLANACEAE

Cuatresia trianae Hunz., Caldasia 15: 143 (Hunziker 1986).
Figure 1H

New records. Coclé. Vicinity El Copé, 5–6 mi. N of El Copé, along trail which leads into the lowlands from old Riviera saw works area; 08°40′14″ N, 080°35′34″ W–08°41′18″ N, 080°35′58″ W; 600–800 m; 8 Jul. 1994; *T.B. Croat & G.H. Zhu 77214* (MO). **Colón.** MPSA mining site, forested slopes along Quebrada Petaquilla; 08°49′16″ N, 080°40′26″ W; 150 m; 2 Sept. 2014; *G. McPherson et al. 21565* (MO). Figure 5C.

Global distribution. Colombia, Ecuador, Panama, and Peru.

Identification. It is recognized by having strongly roughened blades, dense inflorescences with few flowers (5–10 flowers), densely pubescent flowers with lobed calyx, bell-shaped corolla (with conspicuous inter-petal membrane) and non-exerted stamens (Hunziker 1986; Canal and Orozco 2010). In Panama, *Cuatresia trianae* could be confused with *C. exiguiflora* (D'Arcy) Hunz., but the latter differs in having lax inflorescences, glabrous flowers and ellipsoid berries (Canal and Orozco 2012).

VIOLACEAE

Paypayrola confertiflora Tul., Ann. Sci. Nat., sér. 3 7: 373 (Tulasne 1847).
Figure 2G

New records. Coclé. Parque Nacional General de Divi-sion Omar Torrijos Herrera, La Rica, bosque cercano al río Juan Julio; 08°42′59″ N, 080°35′30″ W; 240 m; 23 Jul. 2013; *O. Ortiz et al. 1475* (MO, PMA). **Colón**. Distrito de Donoso, área de concesión de Minera Panamá, Campa-mento 600, área 4; 08°49′26″ N, 080°39′32″ W; 230 m; 7 Jun. 2012; *J.F. Carrión 785* (PMA); ibid., Coastal Road 17k-700; 08° 56′08″ N, 080°41′32″ W; 61 m; 13 Nov. 2013; *R. Flores 3424* (PMA); Teck Cominco Petaquilla min-ing concession, slopes along exploration road; 08°50′22″N, 080°38′51″ W; 184 m; 15 Sept. 2007; *G. McPherson 19558* (MO); ibid., ridgetop forest, near transect C002; 08°50′22″ N, 080°38′ 51″ W; 205 m; 18 Sept. 2007; *G. McPherson 19679* (MO); ibid., ridgetop forest along road; 08°49′29″ N, 080° 40′12″ W; 323 m; 1 Dec. 2007; *G. McPherson & H. van der Wer 19910* (MO); ibid., for-est along ridge road; 08°49′22″ N, 080°39′32″ W; 300 m; 25 Feb. 2008; *G. McPherson & M. Merello 20241* (MO); Site of proposed copper mine (MPSA), forested slopes; 08°48′27″ N, 080°36′ 20″ W; 100 m; 13 Dec. 2009; *G. McPherson & M. Merello 21283* (MO); Botija, Carretera Pionera, similar to prairie clay; 08°50′06″ N, 080°39′17″W; 137 m; 11 Sept. 2012; *H. van der Wer et al. 24441* (MO, PMA). **Comarca Guna Yala**. Río Cangandí, hills W of river S of confluence with río Titamibe; 09°27′30″ N, 079°07′00″ W; 50–150 m; 27 Jan. 1985; *G. de Nevers et al. 4669* (MO); Between río Diablo & río Acuatí

near Narganá; 09°26′34″ N, 078°35′26″ W; 3 Nov. 1967; *J. Duke 14895* (MO); Cordillera frente a Isla Narganá; 09°22′ N, 078°34′ W; 65 m; 12 Aug. 1994; *C. Galdames 1587* (MO. PMA); Vecindad de Río Diablo, desde el campamento Duque Sui hasta Isper Yala; 09°22′ N, 078°35′ W; 70–100 m; 3 Jul. 1992; *Herrera et al. 1210* (MO); ca ½ way between the continental divide and the Atlantic coast opposite Cartí; 09°22′ N, 078°58′ W; 200 m; 23 Feb. 1973; *H. Kennedy 2616* (MO). **Panamá.** 12 mi. on Cartí Road from the Interamerican Highway, then 3 hours walk along road to Atlantic side; 09°23′ N, 08°57′ W – 09°27′ N, 078°57′ W; 30 m; 15 Feb. 1980; *T. Antonio 3782* (MO); El Llano-Cartí Road, km 26.5. Trail NE from road, premontane wet forest, assoc.: *Ormosia coccinea*, *Gnetum leyboldii*; 09°22′ N, 078°58′ W; 175 m; 9 Mar. 1985; *G. de Nevers et al. 5078* (MO); El Llano-Cartí Road, km 26.5, trail to río Cartí Chico and up ridge on E side; 09°22′ N, 078°58′ W; 200 m; 7 Apr. 1985; *G. de Nevers et al. 5236* (MO); El Llano-Cartí Road, km 26.5, tropical moist forest, assoc.: *Bonafousia undulata*, *Attalea allenii*, *Theobroma bernoulii*; 09°22′ N, 078°58′ W; 200 m; 14 Apr. 1985; *G. de Nevers et al. 5363* (MO); El Llano-Cartí highway, 14–17 km north of El Llano; 09°17′20″ N, 078°55′22″ W; 335 m; 13 Feb. 1973; *R. Dressler 4270* (MO); Road from El Llano to Cartí, 14.8 km north of the Panamerican Highway; 09°17′18″ N, 078°56′08″ W; 300–500 m; 3 Sept. 1977; *J. Folsom & P. Maas 5221* (MO); 16 km above Pan-Am Highway on road from El Llano to Carti-Tupile, near campsite; 09°17′50″ N, 078°56′15″ W; 350–400 m; 21 Feb. 1973, *H. Kennedy 2542* (MO); El Llano-Cartí road, km 15, rain forest; 09°19′40″ N, 078°57′05″ W; 370 m; 3 Sept. 1977; *P. Maas 2794* (MO); Along El Llano-Cartí road, Forested slopes; 09°15′ N, 079°00′ W; 400 m; 24 Nov. 1985; *G. McPherson 7586* (MO); Along El Llano-Cartí road, forested slopes; 09°15′ N, 079°00′ W; 400 m; 24 Nov. 1985; *G. McPherson 7588* (MO); On El Llano-Carti road, near Nusagandi, along trail to waterfall; 09°15′ N, 079°00′ W; 250 m; 1 Nov. 1992; *G. McPherson & Richardson 16007* (MO). Figure 5C.

Global distribution. Brazil, Colombia, French Guiana, Guyana, Panama, Suriname, and Venezuela.

Identification. It is recognized by having elliptic to obovate-elliptic blades, long-attenuate at base, petioles 5–9 mm, congested inflorescences and flowers with yellow petals (Aymard et al. 2014). In Panama, *P. confertiflora* could be confused with *P. longifolia* Tul., but the latter differs in having obovate to obovate-lanceolate blades, longer petioles (>12 mm) and loose inflorescences.

Information gaps on plant collections in Panama

Geographically, the west of the country (i.e. the provinces of Chiriqui, Bocas del Toro, and Comarca Ngäbe-Buglé), has been relatively well collected (Fig. 6), especially in the mid- and high-elevation areas, such as the Boquete district, the corregimiento of Volcán, and the Fortuna Forest Reserve (Reserva Forestal Fortuna). However, there are still areas with few collections, primarily in lowland forest relics in the southern part of Chiriquí. Bocas del Toro Province has several relatively well-collected locations, both in the lowlands (Changuinola and Chiriquí Grande districts) and at mid and high elevations (La Amistad International Park), but there are still important sites with few collections, mainly in the protected area of the Bosque Protector Palo Seco, which includes some areas of the Comarca Ngäbe-Buglé. The Comarca Ngäbe-Buglé presents many unexplored localities, and the existing collections of this region are concentrated in Cerro Colorado, Ratón, Cerro Santiago, Escudo de Veraguas island (Degó in the indigenous language), and the Damani Guariviara wetlands.

The central region of the country, which includes the provinces of Veraguas, Herrera, Los Santos, Coclé, Panamá Oeste, and certain parts of western Colón, has at least six areas with more than 1700 botanical records (Fig. 6). Collections in the Province of Veraguas are concentrated to the north, in the protected area of Santa Fe and to the south, in Coiba National Park, while the rest of the province is still poorly explored. Similarly, despite some collecting efforts in Santa Fe National Park, this protected area is currently underexplored. The Azuero Peninsula, which includes the provinces of Herrera, Los Santos and the south-eastern part of the Province of Veraguas, has some scattered collections, mainly in protected areas, but other important sites such as the mountains of Cerro Hoya National Park remain very poorly known. In Coclé province, collections are concentrated in the Antón district (Valle de Antón) and the Omar Torrijos Herrera National Park, with still-unexplored areas in the north-east of the province (Penonomé district), such as Chiguirí arriba and the Río Indio area. A large number of recent collections are from the Province of Colón, most of them concentrated in the western part of Donoso district. In the Province of Panamá Oeste, botanical records are located mainly in the Altos de Campana National Park, but there are collection gaps in the northwest (Río Indio area and the corregimientos of Ciri Grande, Cirí de Los Sotos, and Ollas Arriba).

The Canal area (the old Canal Zone), which includes the central part of Colón and the western part of the province of Panama, undoubtedly represents the portion of the country with the most botanical records (Fig. 6). The protected areas bordering the Panama Canal, such as Barro Colorado Island, Bosque Protector San Lorenzo, and the National Parks of Camino de Cruces, Altos de Campana and Soberanía, have been widely collected.

In the eastern part of the country, in the province of Panamá there are many botanical records, but these are concentrated in the areas near Panama City, Chagres National Park (including Cerro Azul and Cerro Jefe), and the central part of the province, mainly in the district of Chepo (along the road from El Llano to Cartí); the rest of the eastern part is still virtually unexplored. On the other hand, the eastern part of the province of Colón has been widely explored in the Portobelo area, but many

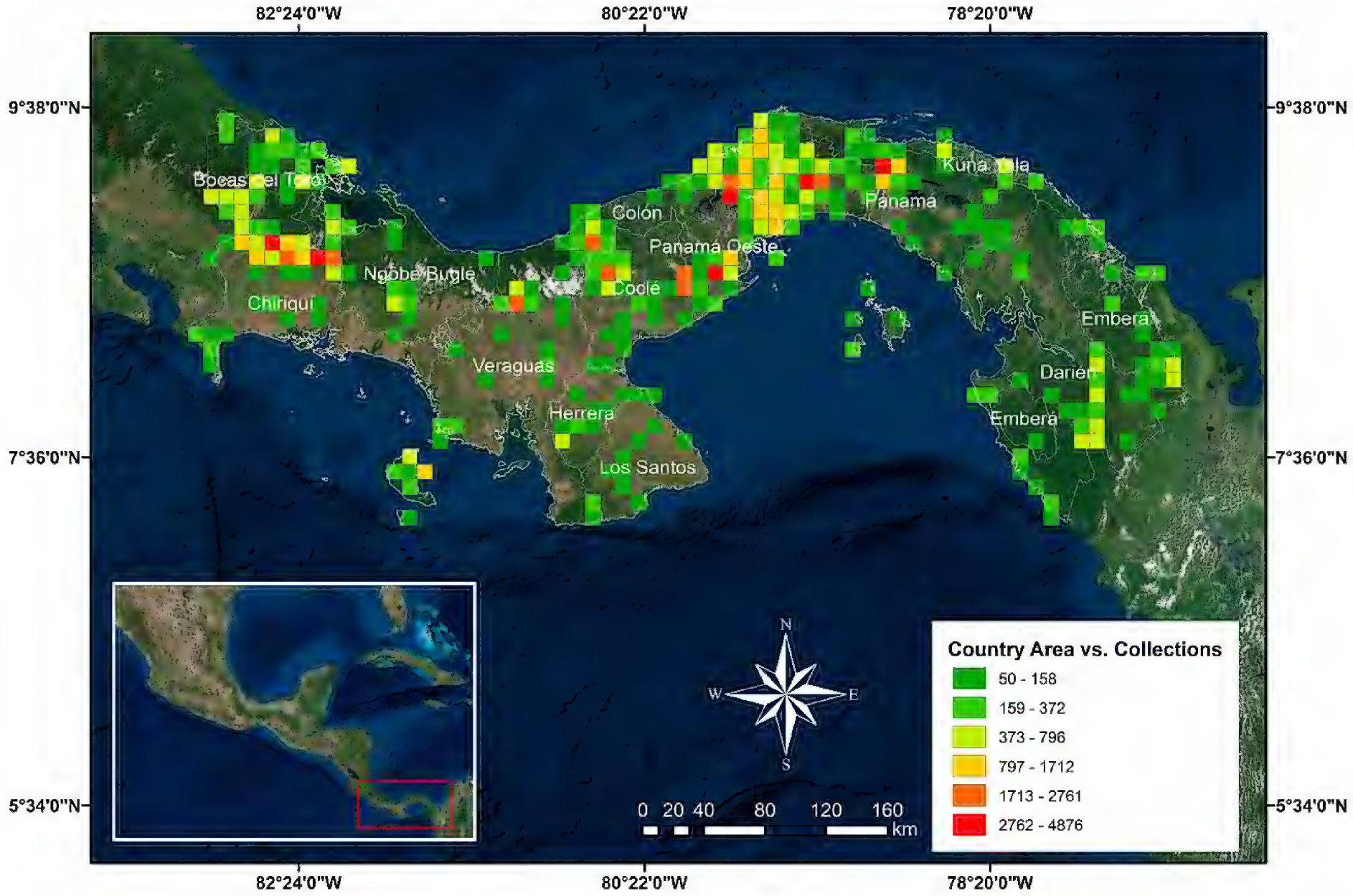

Figure 6. Main areas with gaps of information on plant collections in Panama.

parts of the province are still undercollected, primarily in the eastern part near the Comarca Guna Yala. The remaining sites of the eastern part of Panama (the least explored region of the country) have very few botanical collections. Only nine localities have more than 300 collections, seven of them in the province of Darién (for example, the Pirre and Cana Mountains) and two in the Comarca Guna Yala.

Discussion

In summary, most collections have been made in the Canal area and the western part of Panama (specifically in Chiriquí Province). Furthermore, there are only five locations with more than 2500 botanical records (Fig. 6). Many of the sites identified here as having few collections correspond to areas with high endemism and diversity and are important biodiversity conservation sites (Myers 1969; Lewis 1971; Powell et al. 2018a, 2018b).

In recent years, many new records and new species have been added to the Panamanian flora. This suggests that there are still information gaps and are probably due to the following reasons:

- Panama is a small country (75,845.072 km^2) and most of its territory is anthropic (towns, highways, roads, energy plants, cultivated areas, etc.), so the remaining fully natural areas are currently very reduced and highly fragmented. According to historical records, it is estimated that in 1850 forest covered 91% of Panama (Arias 2004); however, there has been rapid deforestation throughout the 20th and into the 21st centuries (Killip 1919; Porter 1970; Croat 1972; Kapos et al. 2015). In 1947, 1970, and 1992, the forests covered 70% (53,091 km^2), 53% (40,816 km^2), and 49.3% (36,951.60 km^2), respectively, of the total territory (Garver 1947; Lamb 1953; Hartshorn 1981; ANAM 2010; Kapos et al. 2015). Subsequently, it was reported that the deforestation rate was about 413 km^2 per year, and 134 km^2 per year between 2000 and 2008, which caused the total forest cover to decrease to 33,507 km^2 in 2000, and to 32,433 km^2 in 2008 (Vergara-Asenjo and Potvin 2014). It is likely that due to the continuous reduction of the forest cover in the country during the last 50 years, botanical efforts in Panama have concentrated mainly in the protected natural areas, which occupy approximately 31.8% (ca 24,901 km^2) of the national territory (ANAM 2010).
- The collection sites have probably been the same throughout the history of botanical collecting in Panama. In fact, many sites with considerable botanical records identified in this work coincide with the historically more-visited sites (cf. Dwyer 1964, 1968a, 1968b, 1985; Lewis 1968, 1971; Bogarín et al. 2014a). All these sites have in common easy access, being surrounded by highways, roads, cities and towns. In the past, several botanists had already noticed that one of the most important reasons related to the lack of knowledge of the flora of Panama is the inaccessibility of many mountainous areas far from roads (Dressler 1972; Lewis 1971; Dwyer 1985). This suggests that there are still information gaps, particularly in those regions currently undercollected. For example, 31 of the

46 new records included in this work were recently collected (between 2007 and 2016) in a poorly explored area of Colón Province. These collections are part of a MBG Project that consists in documenting the flora of Donoso district, in which they have collected about 1400 botanical specimens and identified more than 30 new species (TROPICOS 2019b).

• The are few resident Panamanian collectors. Historically, foreign botanists made most of the collections in Panamanian territory over short periods of time (Dwyer 1964, 1985; Dressler 1972). Dressler (1972) emphasized the importance of training local resident collectors in Panama, arguing that they are more familiar with the local flora and would avoid collecting in the same areas repeatedly, thereby increasing the possibility of finding novelties. Expert collectors (sometimes referred to as "mega-collectors") have proven successful in the search for new species for science, mainly due to the experience of having collected in several places (Bebber et al. 2012; Whitefield 2012). Currently in Panama, there are very few botanists who are exclusively dedicated to collecting plants, and local herbaria do not have sufficient budgets to hire botanists dedicated to research on the local flora. The collections made recently are mainly due to ecological or floristic studies related to projects of economic or social interest. Experienced general plant collectors are currently few in Panama, even though, in order to ascertain the biodiversity importance of the undercollected or poorly known areas discussed and their vulnerability, additional floristic and taxonomic studies are needed. Consequently, the training of local botanists is necessary as well as the collaboration between local and international specialists. Furthermore, a detailed mapping of Panama's biodiversity (like the one carried out in Costa Rica by INBio) is clearly needed. Another factor limiting an integrated knowledge of the Flora of Panama is the lack of an updated Flora of Panama, representing the current state of floristic knowledge, rather than that of the last decades of the last century.

In the name of the common good, we hope that these suggestions will be considered by local government officials and institutions, such as the Secretariat for Science, Technology and Innovation (SENACYT), Ministry of Environment of Panama, University of Panama (UP), UNACHI, STRI, Institute of Scientific Research and High Technology Services (INDICASAT), National Association for the Conservation of Nature (ANCON), Technological University of Panama (UTP).

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Authors' Contributions

OOO collected and identified part of the material, made part of the identification notes and wrote the manuscript. RF collected and identified part of the material and made part of the identification notes. GMP collected and identified part of the material, contributed to the design and implementation of the research, and reviewed all manuscript. JFC collected and identified part of the material and made part of the identification notes. ECP prepared the maps and made part of the identification notes. RMB supported the publication through UNIFI, collected and identified part of the material, made part the identification notes, co-wrote the discussion and reviewed all manuscript.

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